Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

FOR ALL POWER ENGINEERS • STEAM, ELECTRICITY AND ALL OTHER POWER ENGINEERING SERVICES

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The PRACTICAL ENGINEER and ELECTRICIAN

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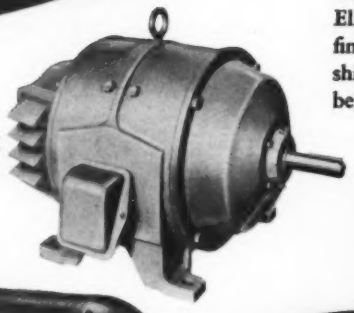
APRIL 1951

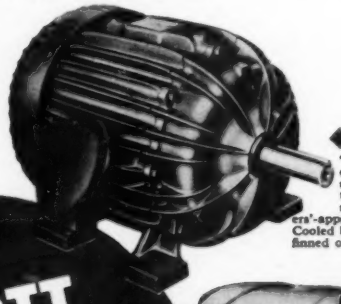
TECHNICAL PUBLISHING COMPANY • CHICAGO, ILLINOIS

In motors from 1 hp up you're a step

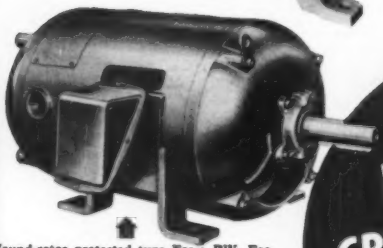
Looking for a dependable motor in any standard type, 1 hp or larger? You'll find it in this complete line, with the backing of the Crocker-Wheeler name plus the Elliott name—double assurance that you're getting as fine a motor as skilled engineering and veteran workmanship can turn out... Some representative types shown below. Write for bulletins.



DC dripproof and drip-proof-protected types Form F, in ratings to 7½ hp. Form H, 10 to 200 hp.

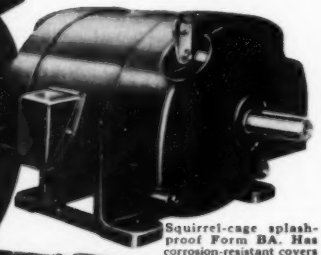


"Sealedpower" totally-enclosed fan-cooled squirrel-cage motors, 3 to 125 hp. Also explosion-proof underwriters'-approved, 20 to 125 hp. Cooled by air blown along the finned outer case.

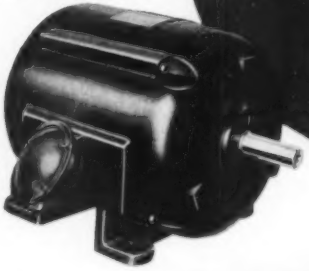


Wound-rotor protected type Form BW. For slow, smooth acceleration, high starting torque with low starting current, or variable speed. Drip-proof, splash-proof, 1 to 200 hp.

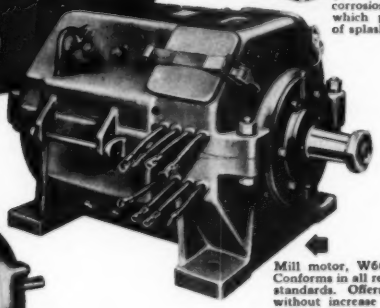
ELLIOTT
CROCKER-WHEELER
Integral
motors



Squirrel-cage splash-proof Form BA. Has corrosion-resistant covers which prevent entrance of splashing liquids.

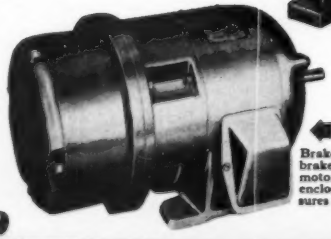


Squirrel-cage, totally-enclosed, non-ventilated Form BE. Available up to and including 3 hp at 1800 rpm, for applications requiring protection against dust, fumes, moisture.

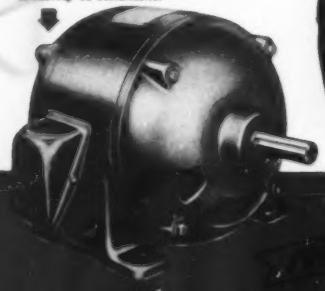


Mill motor, W600 Series, DC. Conforms in all respects to AISE standards. Offers more power without increase in frame size.

Squirrel-cage protected type Form BA. An open dripproof motor for general purpose use. Available in wide modifications to meet a variety of conditions.



Brake motor using latest disk type brake mounted on BA dripproof motor. Also available with totally enclosed and splashproof enclosures for AC or DC applications.



ahead with ELLIOTT

Looking for a really big motor—big in quality as well as capacity? These fine Elliott motors have the exceptional strength and rigidity of welded steel construction in frame and spider with a number of other notable advantages. Fabri-steel construction marks the greatest advance in large motor design and construction since the turn of the century. Some of these outstanding motors are illustrated below. Bulletins for the asking.

Synchronous motor for gas compressor drive. Available with solid or split rotors, open or enclosed, engine type or coupled type, rigid construction.

Totally-enclosed fan-cooled motor, cooled by heat exchanger located at top of unit. Two-pole ratings 300 to 4000 hp. For lower speeds, sizes equivalent to 50-hp, 14-pole, to 3000-hp, four-pole.

Large two-pole squirrel cage induction motor (350 hp up). A long forward step in two-pole design. Typical Elliott welded steel construction enables widest variation in type of enclosure.

Squirrel-cage induction motor, four to 14 poles, 150 to 2000 hp. All enclosure types.

Outdoor splashproof squirrel-cage induction motor especially designed for outdoor installation without protective covering. 150 hp, 14 pole to 2000 hp, four-pole. 300 hp to 1000 hp two-pole.

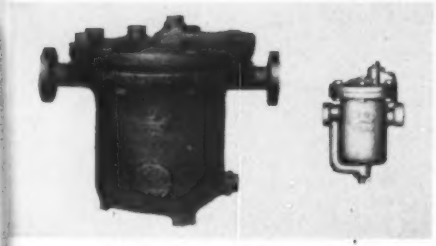
Wound rotor induction motor. Simple, strong fabricated construction, sleeve or anti-friction bearings. Available in all types of enclosure.

Vertical outdoor splashproof squirrel-cage induction motor. Can also be made in open drippproof or indoor splashproof with minor changes in ventilating baffles.

L-800

FOR BIG TRAP CAPACITY IN A SMALL PACKAGE ...buy Armstrongs

SIZE FOR SIZE THEY GIVE YOU MORE



FROM THE RIDICULOUS TO THE SUBLIME . . . **The monstrosity on the left is a steam trap once manufactured in Germany. It weighs 116 lbs. but has no more capacity than the 10½ lb. Armstrong trap on the right. All of which is a means of focussing your attention on the importance of a steam trap leverage system. The size of the big trap is necessary due to its crude-by-comparison leverage design.**

ARMSTRONG steam trap capacity is a bargain size for size because of the patented leverage system. In an Armstrong trap for 100 psig, leverage is higher than in one for, say, 15 psig. Thus, a larger valve can be opened than would be possible if the leverage was the same for all pressures.

That sounds simple, but isn't. If higher leverage is secured with a longer lever arm, a bigger trap body is needed. That's the trouble with the elephant shown at the left. Also the design must permit the valve to open *wide* or it will restrict the orifice, reducing capacity. *Armstrong's design answers these problems better than any other design.*

P. S. When comparing traps be sure capacities are based (as are Armstrongs) on *actual* tests with condensate at steam temperature. No other basis is reliable. ARMSTRONG MACHINE WORKS, 810 Maple St., Three Rivers, Michigan.

SEE OUR CATALOG IN SWEET'S

The 36-PAGE STEAM TRAP BOOK gives dimensions, weights and *actual* capacities of Armstrong traps. Write for a copy or Call your local Armstrong Representative.

ARMSTRONG STEAM TRAPS

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CHICAGO: Arthur L. Rice, Jr.
John R. Morrison
110 S. Dearborn St., Chicago 3, Ill.
Phone: DEarborn 2-5446

NEW YORK: George L. Wright, Jr.
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CLEVELAND: Richard M. Ward
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Phone: Main 3860

SOUTHWEST: McDonald-Thompson
Richard C. Wipperman
McDonald-Thompson
1118 Odeans Drive
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Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

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April, 1951

VOLUME 55—NUMBER 4

Notes on This Issue

Semi-Outdoor Station (for 40° Below Zero)

The Frank Bird Steam-Electric Station is probably the farthest north of any semi-outdoor power plant in the world, way up in Montana. We have published a good deal of material on outdoor plants over the past 8 years but most of them have been located in the mild climate of the southern parts of the country. It all started because engineers began to ask themselves. "Why put a building around a boiler which is practically a building itself with a weatherproof cover?"

Rising building costs stimulated the idea and you saw the description of the Greens Bayou Station in our April 1950 issue where every single item of equipment is outdoors except for a small control room.

The Frank Bird Station presented interesting problems in centralized control. It includes a single 66,000 kw turbine-generator served with 950 psi, 900 F, steam by a 675,000 lb per hour boiler.

600 Mile, 380,000 Volt Power Line

In this issue you will find an extremely interesting article on power developments in Sweden. Among other things is this longest, highest voltage transmission line in the world, which will run from Harspranget, north of the Arctic Circle to Hallsberg in central Sweden, where power is stepped down (!) to 200,000 volts. Then there's the 55 mile single conductor cable to the island of Gotland which will operate at 100,000 volts *direct current* and the return path is through sea water. No electrical engineer can afford to miss this fascinating tale.

Also in This Issue

—The story of a municipal utility that has grown from a 60-hp engine to 7150-hp in Diesels.

—Cost figures on three separate types of factory power plants burning wood waste, showing benefits of modern engineering.

—Rehabilitation of Narrows Power Plant of The Virginia Railway. Forceful example of the high cost of neglect.

A Power Plant Laboratory

A reader of Power Engineering since 1926 asked for help in designing and equipping a laboratory for his power plant for routine analysis of water and lubricating oil. So we asked other readers for suggestions in the December issue. The response was overwhelming. Mr. S. M. Sperry, Chief Chemist of Gilbert Associates, Inc., of Reading, Pa. (and an enthusiastic Power Engineering reader) contributed this splendid article on the subject. It describes an up-to-date chemical laboratory for power plant analyses in complete detail—specifications, photographs, dimension drawings, construction details, and cost estimates.

Practical Engineer Section

Note: "The Practical Engineer" was the title of Power Engineering from 1896 to 1917, twenty-one years. In 1939 the "Practical Engineer" title was brought back as a section of Power Engineering and for the past 12 years has been a very popular feature.

This month the "Practical Engineer" starts off with some very useful incidents from the wealth of experience of Dan Gutleben one of which saved half a million dollars for Pennsylvania Sugar Corp.

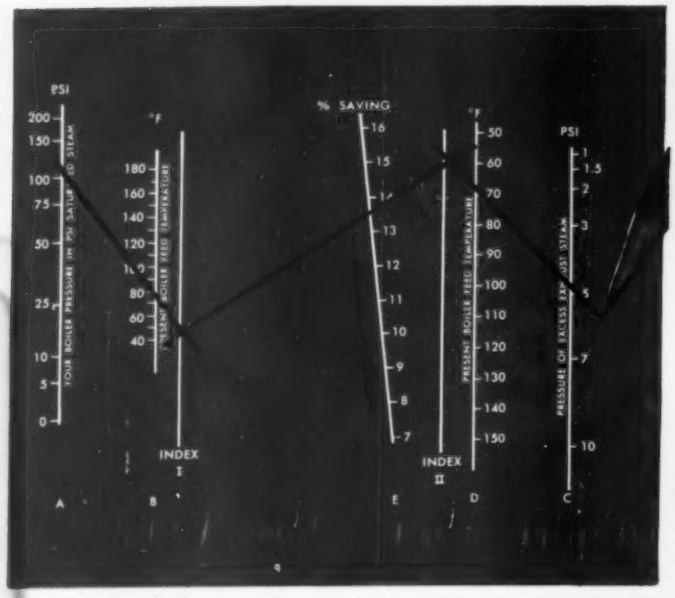
Paul Schmidt's series on "Characteristics of Fuel Oil" is concluded in this issue. Demand for back copies and tear sheets of this series has been so heavy we've run out but fortunately the material is to be printed in book form.

Another piece tells how a tramp engineer accomplished a modern version of Peter, the Dutch boy, and the leak in the dyke. He saved the day when a new concrete dam sprang a leak as they were starting to fill the reservoir.

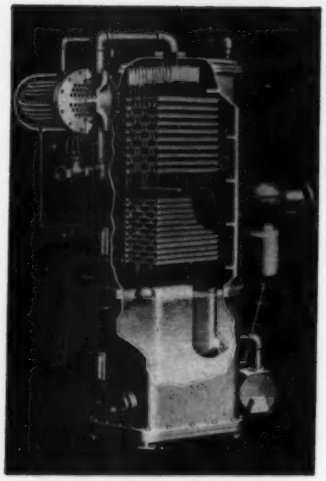
As usual there are highly practical "Hints and Kinks," "Questions and Answers" straight from readers and other items of every day usefulness.

Use this chart to figure fuel savings with a Swartwout Feed Water Heater

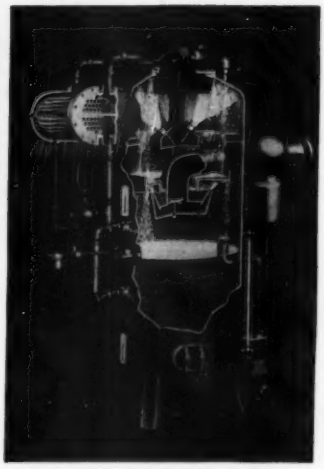
1 Here's how to figure your fuel savings with a Swartwout Feed Water Heater: Connect point on Scale A to point on Scale B and project line to intersect Index I. Connect point on Scale C to point on Scale D and project line to intersect Index II. Connect points on Index I and Index II and read percentage fuel savings on Scale E. The example given on nomogram—100 psi saturated steam boiler using 70°F feed water and 5 psi exhaust steam—shows a representative saving of approximately 13.6% of your present fuel cost.



2 By utilizing the residual heat in exhaust steam, Swartwout Feed Water Heaters can save you approximately 1% of your present fuel cost for each 11°F increase in boiler feed water temperature. In addition, you improve your boiler operation in other important, cost-cutting ways—faster steaming rate, temperature strain relief, removal by deaeration of soluble gases that cause boiler and economizer corrosion. Accessories are furnished to meet the requirements of each particular installation.



3 Swartwout cast iron or steel deaerating heaters (.03 oxygen guarantee) and deaerators (.005 oxygen guarantee) are supplied with cast iron or stainless steel trays. By using the counterflow principle the greatest degree of deaeration is obtained because the water is in contact with clean steam just before dropping into the storage section.



4 Swartwout all-steel spray heaters (atomizing type) give feed water with an oxygen content guaranteed not to exceed .005 cc per liter of water. All surfaces subjected to impingement of water are made of stainless steel. Swartwout heaters are specially engineered to your specifications.

A-5068

Swartwout

POWER PLANT EQUIPMENT

SEND FOR BULLETINS S-18-E, S-210 • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

ENGINEERS' PREVIEW

PLANS for construction of natural gas pipelines into New England beginning in April or May of 1951 and largely completed by early fall, have recently been announced. Two sources of gas, Northeastern Gas Transmission and another to be chosen, combined, will serve the daily maximum requirements of New England communities. Although conversion cost is great, savings expected for consumers and distributors will offset these problems.

★ ★ ★

LLOYD V. BERKNER, elected president of Associated Universities, Inc., succeeded Dr. Frank D. Fackenthal on February 15. Also, Dr. George B. Pegram, elected chairman of board of AUI. Dr. Pegram is also a consultant to the Oak Ridge Institute of Nuclear Studies. Associated Universities is a non-profit corporation formed by nine eastern universities to administer Brookhaven National Laboratory, at Upton, N. Y., under contract with the U. S. Atomic Energy Commission.

★ ★ ★

CONCENTRATED program to train specialists in scientific calculation, critically needed in American mobilization work, is announced by Columbia University. Essential role in program to be played by scientists and machine facilities of IBM Department of Pure Science, including Watson Scientific Computing Laboratory on University campus and giant selective sequence electronic calculator in IBM's World Headquarters in midtown Manhattan.

★ ★ ★

MANUAL OF EQUIVALENT VALVES (See EP December 1950, page 8) has been revised to bring all information up to date as of January 1951. This revision has been necessitated by the various changes in the valves of certain manufacturers resulting in part from the change in supplies of materials during the past few months.

A great many EP readers wrote to us following our initial December announcement of this book and have obtained copies of it. All those who have done so should get in touch with the publisher at once to obtain the revised pages. Since the book is in loose leaf form for this very purpose, the new pages can be inserted and the obsolete ones destroyed.

The publisher is the Hooper Publishing Co., 545 Sansome St., San Francisco 11, Calif., and copies of the book can be obtained from that company for $15.00 per copy.

We do not sell nor handle the book but published a note about it solely as an item of editorial interest, because we feel it is a very valuable compilation of data. The listings show which valves are equivalent and can be specified on an "or equal" basis. The book is well indexed to enable the user to locate the desired information in a matter of seconds.

We'll be very glad, of course, to answer any inquiries about this book, but you can save your time by corresponding direct with Hooper Publishing Co. at the address noted above.

BRAIN TEASER:—Try your cerebral facilities (elegant language for brains) on this one. Answer at bottom of page 8, by courtesy of *The Gilcrafter*.

The average 10-in. phonograph record has 7 in. of playing space. If the record turns 225 times from start to finish, how far does the needle travel?

★ ★ ★

RADIOACTIVE glass beads are being manufactured and used in biological studies by scientists of the Argonne National Laboratory's Division of Biological and Medical Research, developed by research team composed of Walter Kisieleski, George Svihla, and Austin M. Brues. Makes it possible to expose very small areas of an experimental animal to extremely large doses of radiation. Makes possible irradiation of an animal's internal organs, for glass beads can be imbedded in living tissue. Prior to manufacture of these beads study of this type not possible.

★ ★ ★

DO YOU have products such as gaskets, brooms, office supplies, fire fighting apparatus, bathroom fixtures, furniture or the like you want to sell to the Federal Government? To do this with the least delay and involvement in red tape, get yourself in touch immediately with the General Services Administration, Federal Supply Service, which has established regional offices in Boston, New York, Washington, Atlanta, Chicago, Kansas City, Dallas, Denver, San Francisco and Seattle. These offices will supply necessary data, specifications and forms and full information on just how to sell your commodities to the Government. New processing orders for small amounts are used to speed up transactions. Also, certain general classes of Federal supplies will be purchased through different regional offices. Contact your nearest regional office, as noted above, or get in touch with Clifton E. Mack, Commissioner, Federal Supply Service, General Services Administration, Washington, D. C.

★ ★ ★

MANUFACTURERS of new products for hotels should take heart from figures recently announced showing that 1950 was greatest year for new hotel building in more than a decade. During that period 92 new hotels, costing more than $110,000,000, were completed, started or planned. When finished will account for 12,736 guest rooms in 78 different cities; 52 are transient, 34 resort and 5 residential hotels.

★ ★ ★

MOST expensive single machine tool ever purchased by Allis-Chalmers, costing more than $600,000, now in operation at West Allis Works. It is 30-foot heavy boring and turning mill built by Lima-Hamilton Corporation. Can machine single pieces up to 30 ft, 5 in. in diameter and 17 ft high. It increases Allis-Chalmers' capacity for handling large generators, condensers, steam and hydraulic turbine parts. New mill supplements work now being done on 40 ft boring mill installed by Allis-Chalmers in 1928—largest in shops and one of largest in world.

THE United States has given Italy the go-ahead sign on a $416,000,000 program of employment and factory expansion to turn Italy's industries into an arsenal for the Atlantic pact nations, according to a recent AP dispatch.

How much of the cost the United States has agreed to pay in loans or credit has not yet been disclosed. Under the program Italy would put to work some of her 2,000,000 unemployed and put into defense production many of her partly idle factories.

An important factor in this program is inclusion of a number of 900 psi 900 F steam power plants to provide standby for Italy's hydroelectric power system which supplies the bulk of the power to industry. Whenever the output of the hydro plants is curtailed, either because of freeze-ups in winter or lack of water in summer, factories have to shut down. Workmen are laid off and they become fertile grounds in which Communist agitators sow seeds of discontent. If these shutdowns can be prevented by a properly coordinated hydro and steam system that can supply sufficient power continuously, one of the principal causes of Italy's unemployment and discontent will be overcome.

★ ★ ★

PLANS are under way for two new buildings in East Pittsburgh to increase by 65 per cent the capacity of Westinghouse Electric Corp. to produce giant electric generators. These will make possible, it is stated, construction of larger than 150,000 kw high speed 3600 rpm generators.

★ ★ ★

NATIONAL defense and higher living standards both within our reach, say 4 of America's top-ranking economists acting as a committee of the Twentieth Century Fund, but only if we succeed in carrying through realistic program of economic mobilization. Committee calls upon all Americans to accept personal sacrifices and reduced consumption in initial stages of rearmament. Says that if we succeed in first phase, we have chance to progress toward twin goals of adequate defense and rising living standards. Committee looks upon present general wage-price freeze as stop-gap measure to halt spiral that was distorting balance between all prices and wages. Committee says price control must be backed by allocations in many directions and some rationing, must have far better support from fiscal credit and debt management policy, if it is to survive.

★ ★ ★

AMERICAN Standards for America's Emergencies are discussed in considerable detail in booklet PMI26, recently published by American Standards Association. It tells decisive role standardization played in World War II and something of what we may expect in the present mobilization. It describes work now going on in war standards, indicates some of tremendous gaps to be filled if we are to make best possible use of American techniques, manpower and natural resources. For copies of the Booklet, address American Standards Association, Inc., 70 E. 45th Street, New York 17, N. Y.

★ ★ ★

DR. RALPH G. OWENS, named assistant dean of engineering at Illinois Institute of Technology. He has been professor of mechanical engineering since 1946. He replaces Chester A. Arents recently named coordinator of research at IIT.

TO MEET present emergency, schools of engineering and of mines at University of Pittsburgh will conduct regular 12-week summer semester from June 18 to September 7, 1951, for students in all classes. These programs will be part of total program in which they are enrolled. Present demand for engineers to meet military and civilian needs makes it highly desirable that all students in the schools of engineering and of mines attend the summer semester, according to Professor Howard E. Dyche, acting dean. Any student not attending the summer semester must make application for readmission for the fall semester or any subsequent semester.

★ ★ ★

GENERAL Electric Co. in 1950 broke its all-time record for production of large turbine generators, according to Glenn B. Warren, Manager of the G-E Turbine Division. The company's new turbine plant at Schenectady, in its first full year of operation, produced units with a combined capacity of 2,866,000 kw.

Based on current manufacturing schedules, Warren said, 1951 output of large units from Schenectady plant, and smaller units from plants at Lynn and Fitchburg, will be materially greater than any previous year in the history of the company, if certain critical materials are available in sufficient quantities for these purposes. Production of this equipment is so vital to national security that we are certain such materials will be made available despite other urgent demands, Warren said.

★ ★ ★

NEW CONTINUOUS process for manufacture of tetraethyl lead has been perfected by du Pont research men and engineers to bolster United States defense needs. Construction is starting immediately on first new continuous production unit to have annual production capacity of about 50 million pounds of tetraethyl lead a year. At present tetraethyl lead made in batches. New continuous process eliminates need for equipment made of special steel alloys essential in batch process. This makes these critical metals available for other defense uses.

★ ★ ★

ANSWER TO BRAIN TEASER on page 7: — Chances are, if you didn't peek, you tried out some fancy mathematics on this. Just as we did. If so, your face may be red now, just as ours was.

Actually, the record does most of the traveling. The phonograph needle travels only a little over 3½ in.— the straight line distance from the outside of the playing surface to the inside. Actually it travels an arc whose radius is the length of the pick-up arm and whose chord is 3½ in.

This little problem illustrates how easy it is to confuse a reader by deliberately putting in something to lead his mind off the right track—"the record turns 225 times from start to finish"— also how hard it is to read and understand exactly what the words say and not what you think they say. This is a good exercise in semantics.

★ ★ ★

STEEL'S Frozen Locker is what Sidney Feldman calls Kiirunavaara, a mountain estimated to contain 1,500,000,000 tons of high grade iron ore near the town of Kiruna in Swedish Lapland. In very interesting illustrated article in *Steelways*, January 1951, Mr. Feldman describes extent and importance of this deposit, how the ore is recovered and transported, and some of problems of working in far northern climate.

A gearturbine built to save...

Three ways

The Westinghouse Gearturbine costs less to buy . . . less to install . . . and less to maintain. Wrapped up in a single package is a compact, rugged and reliable speed-reduction unit solidly coupled to a Type E turbine. It's the ideal combination for ratings up to 500 hp and output speeds commonly found in single-ended applications.

Here's economy made possible by a standardized design that cuts manufacturing costs . . . avoids costly specials . . . saves space . . . and simplifies maintenance. And you get the maximum flexibility possible . . . any combination of three turbine wheel sizes, three gears and three types of governor can be used according to your needs.

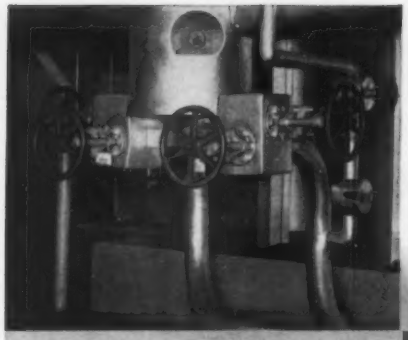
Other plus features are . . . solid coupling of turbine shaft to pinion shaft; single-helical gearing; forced circulation, filtered oil; and 3-point support for easy mounting and leveling.

J-50521

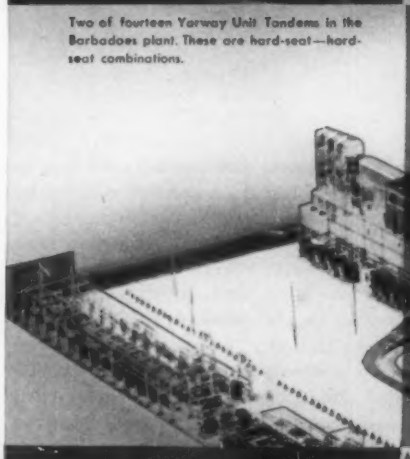
GET THE FULL STORY. A newly available booklet, B-4346, clearly explains the applications, refinements and advantages of Westinghouse Gearturbines. Ask your nearby Westinghouse representative for your copy, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

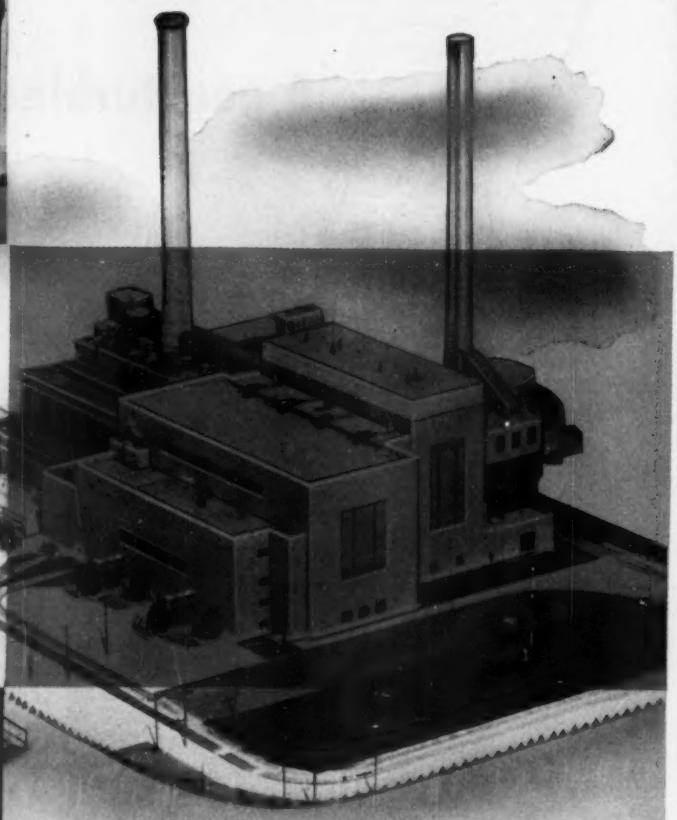
YOU CAN BE SURE.. IF IT'S
Westinghouse
TYPE E Turbines

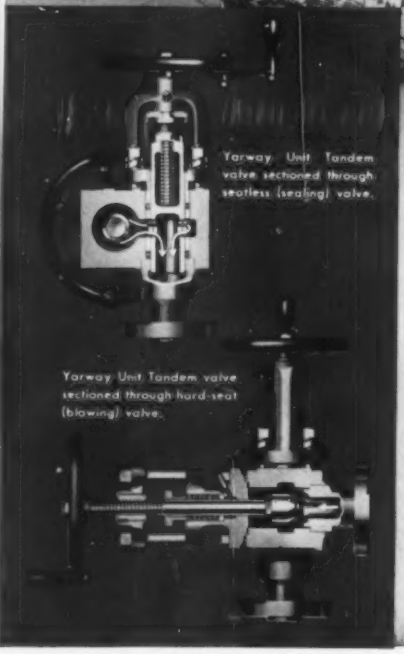
BARBADOES BOILERS GET



Two of fourteen Yarway Unit Tandems in the Barbadoes plant. These are hard-seat—hard-seat combinations.







Yarway Unit Tandem valve sectioned through seatless (sealing) valve.

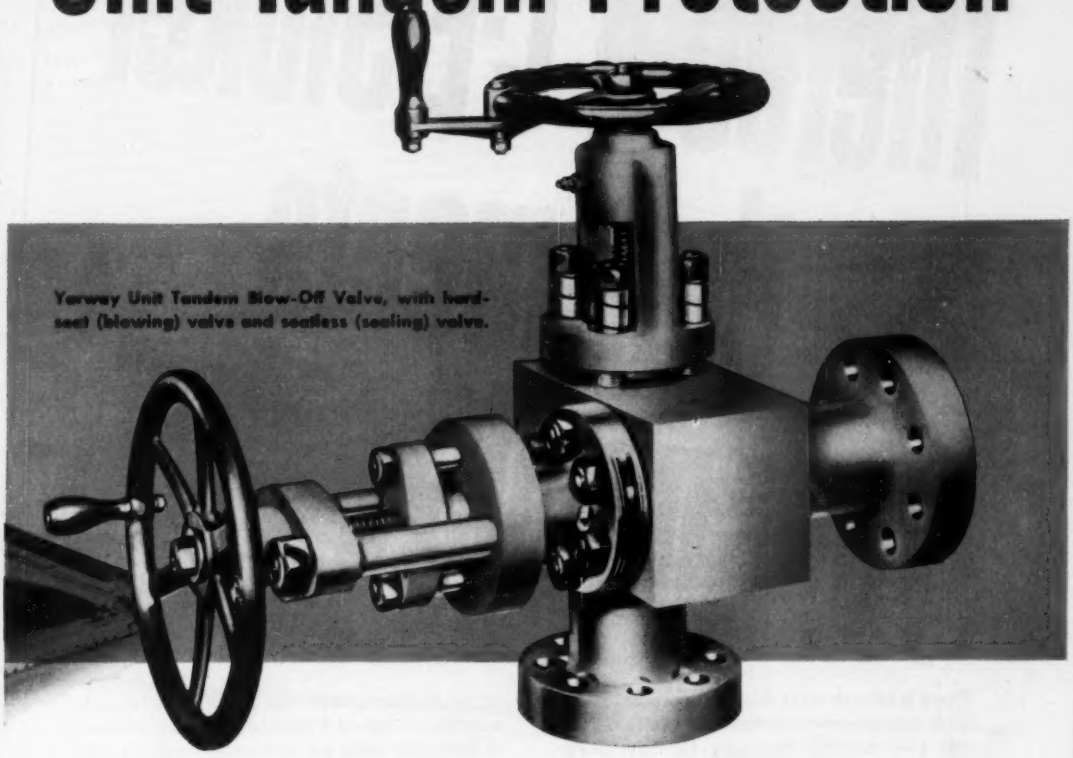
Yarway Unit Tandem valve sectioned through hard-seat (blowing) valve.

■ When a company has a $25,000,000.00 stake in the future such as Philadelphia Electric Company does in its Barbadoes Station —then protects the boilers of that plant with Yarway Unit Tandem Blow-Off Valves—it's significant of the dependability of those valves.

Barbadoes is a fine example of modern power plant engineering, demonstrated by the fact that only 11 men per shift are needed for operating this 180,000 KW station.

YARWAY

Unit Tandem Protection



Yarway Unit Tandem Blow-Off Valve, with hard-seat (blowing) valve and seatless (sealing) valve.

Yarway Unit Tandem Blow-Off Valves also are a good example of steam equipment engineering—used in more than 4 out of 5 high pressure boiler plants in the country.

Rugged construction makes Yarways strong and tough enough to withstand severest blow-down conditions. Metallurgical improvements make them resistant to the reactions of periodic acid wash. *Outages are rare where Yarway boiler valves are used.*

Unit tandems are available in various combinations to meet all pressure and service requirements.

Write for Bulletin B-433 for full details on Yarway Unit Tandems. For lower pressure blow-off valves, write for Bulletin B-424.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

STEAM PLANT EQUIPMENT

There's a C-E Stoker that meets your needs exactly

There is no such thing as an "all purpose" stoker. Each type has advantages that are fully realized only when matched with coals of definite characteristics under well-defined operating conditions.

The importance of getting the *right* stoker is readily seen when you consider that the price you pay for it is only a down payment on the continuing cost incident to steam generation. Why? Because the cost of fuel burned every year throughout the useful life of the equipment far exceeds the original purchase price of the stoker. And, at today's coal prices this fact is of paramount interest to you.

Although the complete line of C-E stokers includes seven basic designs, one of the three types shown on the opposite page will prove to be most suitable in 4 out of 5 installations. Each of these stokers represents an outstanding value in its respective field. Each reflects the practical knowledge of fuel and operating conditions Combustion has gained through 65 years experience in stoker design and application . . . with more than 20,000 installations above residence size.

You can assure yourself of top stoker performance by coming to C-E — stoker headquarters — the next time you are in the market. Since C-E engineers have at their disposal every type of stoker equipment they can afford to be completely impartial in recommending the installation which fits your needs *exactly*. B-408

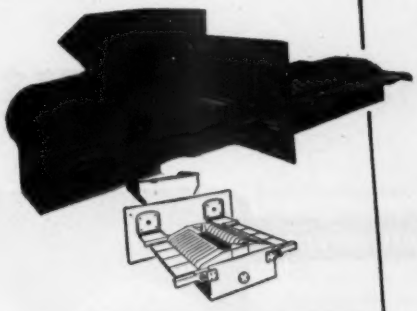
COMBUSTION ENGINEERING

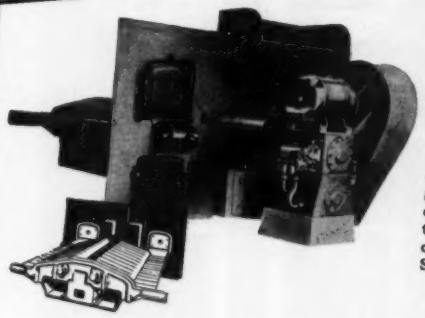
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS, ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

SKELLY STOKER UNIT

Approximate Application Range—20 to 200 boiler hp.

A compact, self-contained underfeed stoker available in designs for burning either anthracite or bituminous coal. An alternate arrangement of fixed and moving grate bars assures lateral distribution of fuel and maintains a clean porous fire. Cantilever dump grates of non-avalanching type simplify ash removal. An integral forced-draft fan, with inlet control, permits positive regulation of air-coal ratio. Sixteen rates of coal feed through variable-speed transmission. Automatic control is standard equipment. Timken bearing equipped. Alemite lubrication throughout.





TYPE E STOKER

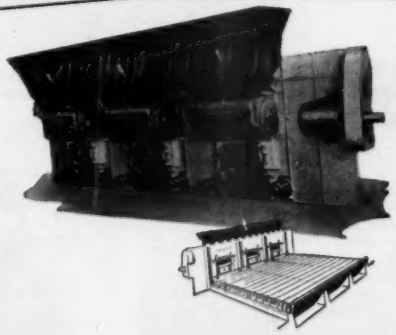
Approximate Application Range—150 to 600 boiler hp.

A single-retort, underfeed stoker designed to burn a wide variety of bituminous coals, particularly those having caking and coking characteristics. The Type E has ram type feed supplemented by a reciprocating sliding bottom. Its grate surface consists of hollow, air-cooled grate bars arranged in an alternately fixed and moving relationship to condition the fuel bed and assure its steady movement to the dump trays which are of the cantilever type. Air supply is under zoned control with provision for introduction of air over the fire. Type E Stokers are available with steam, electric or hydraulic drive.

SPREADER STOKER

Approximate Application Range—150 boiler hp. up to units producing 200,000 lb of steam per hr, or more.

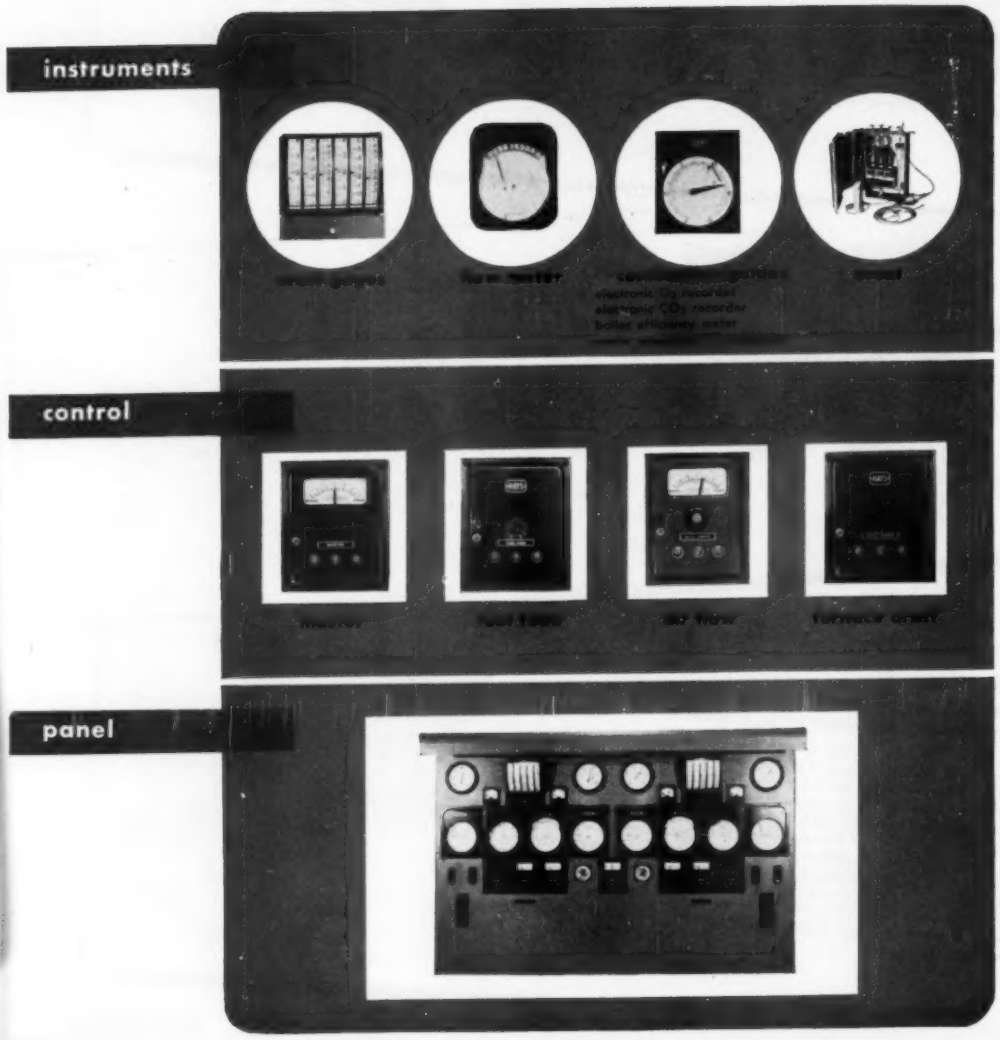
The C-E Spreader Stoker is available in both dumping grate and continuous discharge types. This simple, rugged stoker is designed to burn a wide variety of coals. Hopper, feeding and distributing mechanism, variable-speed drive and motor are combined in a compact unit. Rotating spreader blades feed coal into the furnace in criss-crossing streams which assure uniform distribution. Fines are burned in suspension and the rest of the coal is burned on the grate. Grate surface is zoned for regulating air admission and to facilitate cleaning. All parts subject to wear are readily accessible for inspection, adjustment or replacement, when necessary. Rate of fuel feed and air supply may be regulated over a wide range and are readily adaptable to automatic control.



— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

This HAYS boiler plant line



can give you *results* like these

Increased efficiency "Our basic reason for installing the Hays electric automatic combustion control was to obtain better efficiency. Our aim was more than reached . . . efficiency has climbed, attaining 79.3%."

Plant Engineer
Manhattan Rubber Div.,
Raybestos-Manhattan, Inc.

Rapid response to wide load swings "We have made test runs using the Hays system, bringing the load rapidly up from 8,000 to 80,000 lbs. per hr. with excellent results. Fuel-air ratio was held at the desired value and CO_2 at 15%."

Chief Engineer of Power Plant
Bemis Bros. Bag Company

Good CO_2 "The (Hays) controls in combination with our instruments make it possible to maintain high efficiency, as indicated by the 14½% average. CO_2 obtained, and keep complete records of our operation."

Chief Engineer
Geo. Ziegler Company

Low maintenance "Our aim has always been to eliminate the need for maintenance wherever possible . . . and we are particularly pleased that maintenance has been 'nil' with the (Hays) automatic combustion control system."

Chief Engineer
Kurth Malting Company

Fuel savings "Our fuel cost per pound of steam has dropped so much since we installed (Hays) instruments and combustion control, that fuel savings alone have been enough to pay for the investment in one year's operation."

Power Plant Chief Engineer
Vollrath Company

Efficiency and savings "The Hays combustion control system has played a large part in enabling us to reduce our fuel bill by 20% as well as to achieve an 81% boiler efficiency rating (by metering tests)."

General Power Engineer
Pullman Standard Car Mfg. Co.

tailored to your specifications

Your conditions are different . . . and Hays engineers tailor the instruments, control and panel to *your* requirements.

The result? A control system "customized" for your boiler rating, fuel(s), load swings, steam demand, etc. . . . designed to solve the specific problems which plague you . . . with all instruments and controls mounted on a handsome panel laid out, built, and painted according to your instructions.

how to get results

Hays application engineers will provide consultation on the special problems facing your plant. Through careful analysis, working with your actual operating conditions, they will recommend methods to achieve the results you want. Send us a brief statement of your combustion problem for specific preliminary recommendations, without obligation. Ask for Bulletin No. 49-605 and actual case histories of a wide variety of applications.

THE HAYS CORPORATION
MICHIGAN CITY 7 , INDIANA

Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

Sinclair Rubilene Resists Oxidation Gives Long, Low Cost Service

Oxidation attacks oil wherever there is continuous recirculation—in enclosed crankcase systems and, especially, in central circulating systems. It forms damaging acidic compounds, gum, carbon, and sludge. Result: frictional drag is increased, oil lines may become restricted or closed, wear accelerated, efficiency and life lowered.

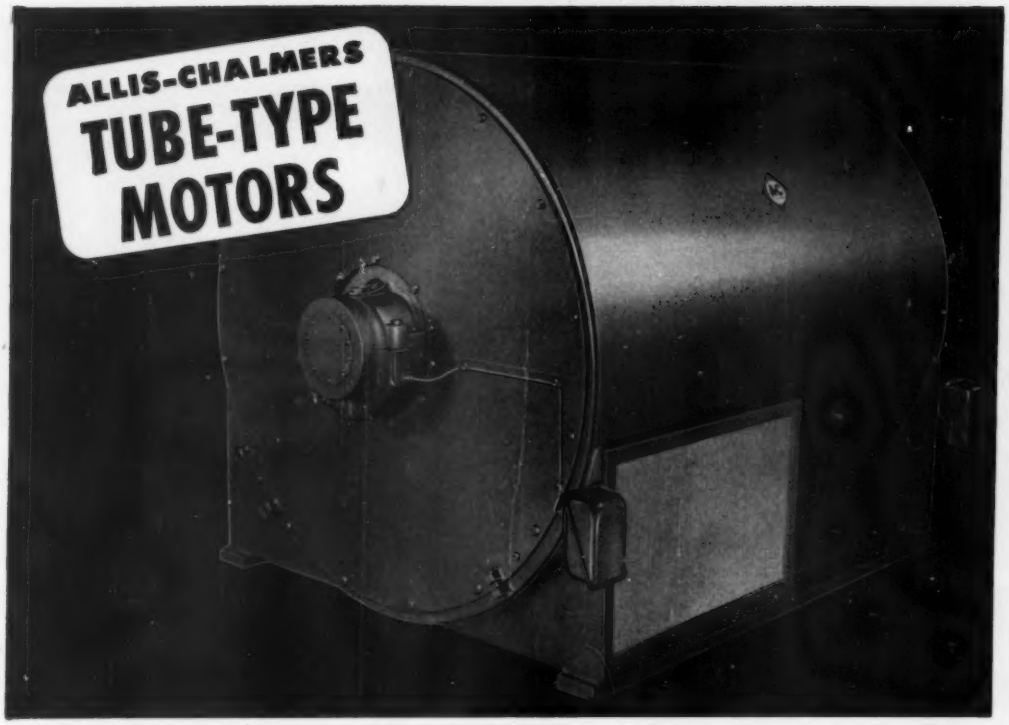
Many years of experience show Sinclair Rubilene successfully withstands oxidation even under sustained high temperatures. This is due to Rubilene's greater stability and ruggedness. At the same time non-foaming Rubilene assures a solid flow of oil to provide a tough oil cushion between all moving parts. Rubilene thus lessens friction and wear and provides high efficiency and smooth operation.

Why not eliminate worry over damaging oxidation and assure reliable lubrication? Use Sinclair Rubilene Oils.

Your nearest Supplier of Sinclair Products will gladly arrange for lubrication counsel, or write to Sinclair Refining Company, 630 Fifth Avenue, New York 20, N. Y.

SINCLAIR

Sustained New-Oil Quality
Long Oil Life
Tough Oil—Less Wear
Circulates Freely
INDUSTRIAL OILS



Self-Cleaning Motor

Keeps Maintenance Costs Down

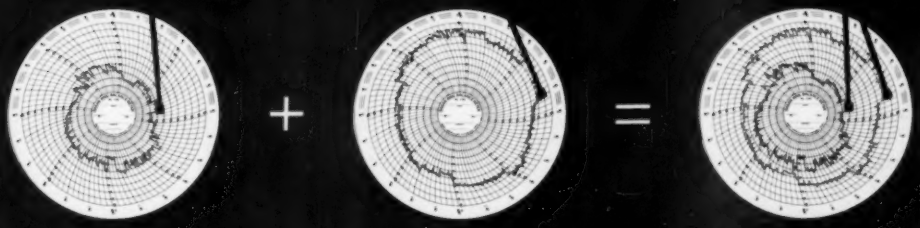
MOTOR CLEANING ROUTINE AND COST ARE PRACTICALLY ELIMINATED by the Allis-Chalmers tube-type, totally-enclosed, fan-cooled motor. Even when installed outdoors in contaminated atmosphere, dirt and corrosion cannot harm it.

The reason for this outstanding performance is the unique tube-type cooling system. Cooling air circulates through a nest of tubes which surrounds the stator, removing heat from the interior of the motor. The generous flow of air through the straight tubes carries dirt out to the atmosphere. There are no corners or pockets, as in conventional designs, which might collect large dirt deposits. If the tubes ever should need cleaning, a brush on a long handle will do the job in a few minutes.

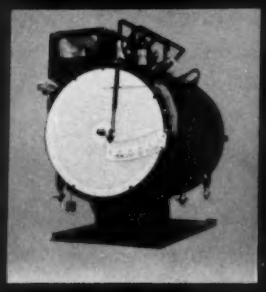
Sizes range from 75 hp up. Tubes and end plates may be made of special corrosion resistant materials where necessary.

To-day, when manpower is high-priced and getting scarce, cutting maintenance time and cost is more important than ever. Ask your Allis-Chalmers representative to show you how this exceptional motor can reduce your maintenance requirements. Or write to Allis-Chalmers, Milwaukee 1, Wisconsin.
Ask for Bulletin 05B7150. A-3322

ALLIS-CHALMERS



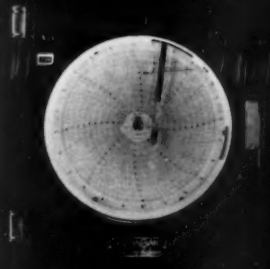
TWO METERS IN ONE CASE —the versatile HAGAN RING BALANCE DUAL METER



The standard case of the Hagan Ring Balance Dual Meter requires only the panel space of a single meter—but it contains *two* complete meters, which may operate independently or be linked together so that one modifies the record of the other.

Here are a few of the things this versatile meter will do:

1. Record two independent flows on a single chart, and totalize either or both. Either flow record may be compensated automatically for temperature and/or pressure.
2. Automatically add or subtract two recorded flow measurements, recording and totalizing the sum or difference.
3. Record a flow which is corrected for density or gravity. In this application the measurement made by one ring acts as a corrector for the measurement made by the second ring. A record of liquid level corrected for density may be obtained in the same way.



Standard ring assemblies may be used in any combination. These are available for measuring maximum differentials from ½" to 420" water column, at static pressures up to 10,000 psig.

We will be glad to furnish full information concerning these or other Hagan Ring Balance Meters.

HAGAN CONTROLS

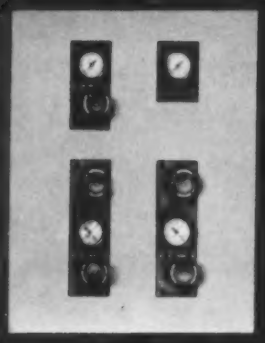
HAGAN CORPORATION

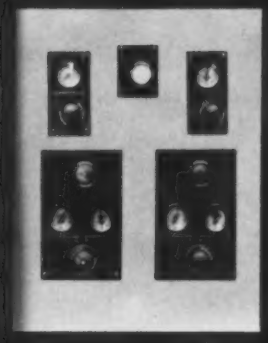
HAGAN BUILDING, PITTSBURGH 30, PA.

RING BALANCE HAGAN Ring Balance

combustion control systems . . . ring balance flow and pressure instruments

FLEXIBLE
PANEL ARRANGEMENT





WITH
HAGAN
PNEUMATIC RELAY STATIONS

Economical use of panel space is a most important consideration.

Each element of any Hagan Pneumatic Relay Station is designed for mounting as an individual unit directly on the panel, or in any combination with other elements on a small sub-panel.

Standard relay elements are designed for remote manual positioning, remote set point adjustment, remote selection of manual or automatic control, remote adjustment for biasing operation of two or more units, remote adjustment of the ratio of fuel and air or of several fuels.

The wide choice of panel arrangement keeps space requirements to a minimum. The variety of relay types is assurance of maximum flexibility and convenience of operation—features which are typical of the *extra values* built into Hagan Automatic Control Systems.

HAGAN

HAGAN CORPORATION
HAGAN BUILDING, PITTSBURGH 30, PA.

RING BALANCE HAGAN Ring Balance

combustion control systems . . . ring balance flow and pressure instruments

Stoker-fired B&W boilers

RING UP LOWER STEAM COSTS

at National Cash Register

The National Cash Register Company, Dayton, Ohio, had a difficult steam generating problem. Located in the heart of its beautiful factory adjacent to a lovely residential section, its power plant was required to minimize pulverized coal fly-ash and smoke from its stack.

To the pulverized coal-fired boiler plant, the company added a B&W stoker-fired boiler of 100,000 lbs. per hour steam capacity.

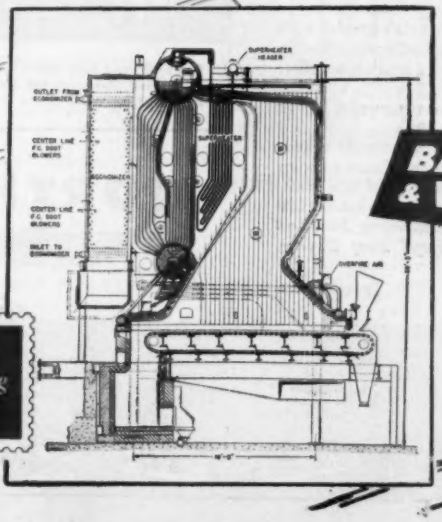
The new boiler more than satisfied expectations. With proper coal it operates at ratings up to 40% overload with complete absence of smoke. It permits the use of less costly strip-mined coals, which replace coals that deliver in Dayton at almost 50% higher prices.

It operates at high thermal efficiency with quick response over a wide range of loads and fuels, and provides trouble-free service at remarkably low maintenance cost.

On the basis of its performance a duplicate boiler was recently installed.

Perhaps you have similar boiler or fuel-burning problems . . . are considering expansion or an entirely new power plant. Why not, like so many others, get the benefit of B&W's 80-year leadership in design, engineering, and building for steam-generating economies.

The Babcock & Wilcox Co., 85 Liberty Street, New York 6, N. Y.



National

Another Example of B&W Engineering for Economy

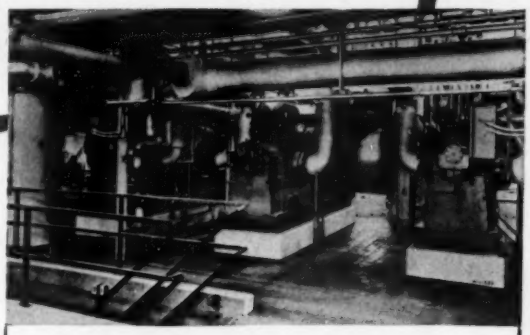
BABCOCK & WILCOX

B&W

G-502

What Metals Are Best For Centrifugal Boiler Feed Pumps?

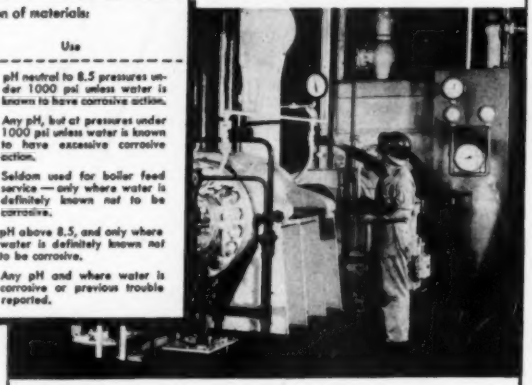
Drawing on their long experience in the field of hydraulics, Worthington engineers produce boiler feed pumps that are metallurgically correct in design, meeting every requirement as to temperature, pressure and corrosion-erosion resistance. As a result, Worthington boiler feed pumps perform better and last longer.



Three Worthington Axially Split Centrifugal Boiler Feed Pumps At The Kansas Power And Light Co. Plant, Hutchinson, Kansas.

The following table represents Worthington's recommendation of materials:

Casing	Fittings	Maximum Temperature	Use
1. Cast Iron	Bronze	250 F	pH neutral to 8.5 pressures under 1000 psi unless water is known to have corrosive action.
2. Cast Iron	13% Chromium Stainless Steel	350 F	Any pH, but at pressures under 1000 psi unless water is known to have excessive corrosive action.
3. Carbon Steel	Bronze	250 F	Seldom used for boiler feed service — only where water is definitely known *not* to be corrosive.
4. Carbon Steel	13% Chromium Stainless Steel	400 F	pH above 8.5, and only where water is definitely known *not* to be corrosive.
5. 5% or higher Chromium Steel	13% Chromium Stainless Steel	Any temperature normally encountered	Any pH and where water is corrosive or previous trouble reported.



One of Several Solid Barrel, Radially Split, High Pressure Boiler Feed Pumps at the Trenton Channel Station of the Detroit Edison Co.

This proven selection of materials coupled with the most advanced design, superior workmanship and a thorough knowledge of application show why . . .

THERE'S A *RIGHT* WORTHINGTON PUMP FOR YOU

. . . *right* for the pressure and temperature of your boiler feed service . . . *right* for maximum economy and dependability. For further proof that *there's more worth in Worthington*, contact our nearest District Office, or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

WORTHINGTON

C1.2

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1000 Ft.
For Flatwell, Condensate, Chilled Water Service
Capacities to 1400 GPM
Heads to 650 Feet
For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1600 Feet
For Water Works, Circulation, Drainage, General Service
Capacities to 135,000 GPM
Heads to 400 Feet
For Boiler Feed Service
Capacities to 1600 GPM
Heads to 3300 Feet
For Boiler Feed Service
Capacities to 3000 GPM
Heads to 7000 Feet

Over 250,000-KW Capacity Operating on . . .

NONPAREIL
TRADE MARK
Turbine Oil

● With the installation of a 45,000-KW turbine shown in the foreground of the illustration above, a large midwest utility now has six large turbines — over 250,000-KW capacity — operating on NONPAREIL Turbine Oil.

There is reason to believe that this new turbine will never have to be shut down for oil replacement, oil-system cleaning, or because of oil-acidity troubles. This conviction is based on the lubrication record of NONPAREIL Turbine Oil in this plant.

During *ten years of operation*, neutralization numbers have stayed below .07 mg. KOH/gm. There have been no time losses or troubles caused by high acidity. Oil systems have stayed clean. Such benefits are assured this company, not only for 10 years, but for the *life* of its turbines. This assurance is based on NONPAREIL's written guarantee that it will maintain a neutralization number below 0.15 mg. KOH/gm.

WITH NO OIL-ACIDITY OR OIL-REPLACEMENT WORRIES

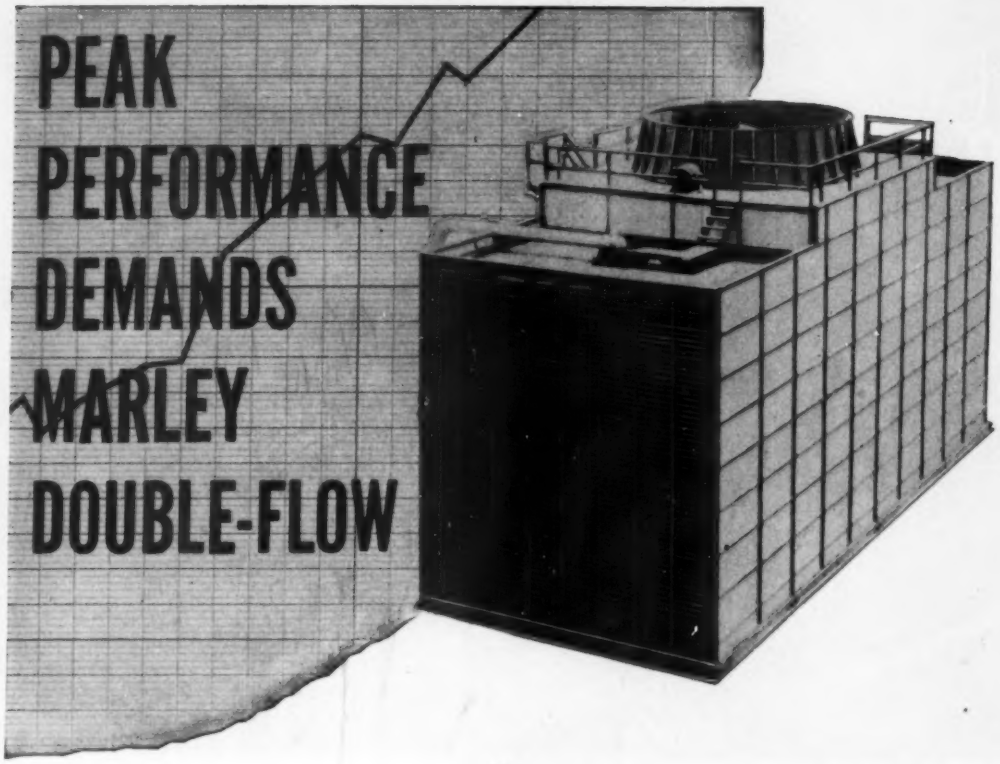
Why not end oil-system maintenance and oil-acidity troubles once and for all, by using NONPAREIL Turbine Oil in your turbines? For more evidence of these savings, ask a Standard Oil Lubrication Engineer to supply you data from 23-year service records of NONPAREIL Turbine Oil.

• • •

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD

PEAK PERFORMANCE DEMANDS MARLEY DOUBLE-FLOW



As the production curve ascends, Marley DOUBLE-FLOW owners increasingly will know the double satisfaction of a good investment and a problem solved.

Marley patented DOUBLE-FLOW design long has been accepted as the standard for functional efficiency. *Now* the exclusive DOUBLE-FLOW features that make for every-minute operation are of utmost importance.

Only DOUBLE-FLOW OPEN DISTRIBUTION permits cleaning in minutes instead of hours and without complete shutdown. Only DOUBLE-FLOW design reveals tower operating condition at a glance. And Marley MECHANICAL EQUIPMENT, engineered for cooling tower service exclusively, is a final assurance of uninterrupted service.

DOUBLE-FLOW has a definite place in your production picture . . . let your nearest Marley Application Engineer explain it without obligation or write for Bulletin DF-50.

Also Producers of

AQUATOWERS
DRICOOLERS
VAIRFLO TOWERS
NATURAL DRAFT TOWERS
SPRAY NOZZLES

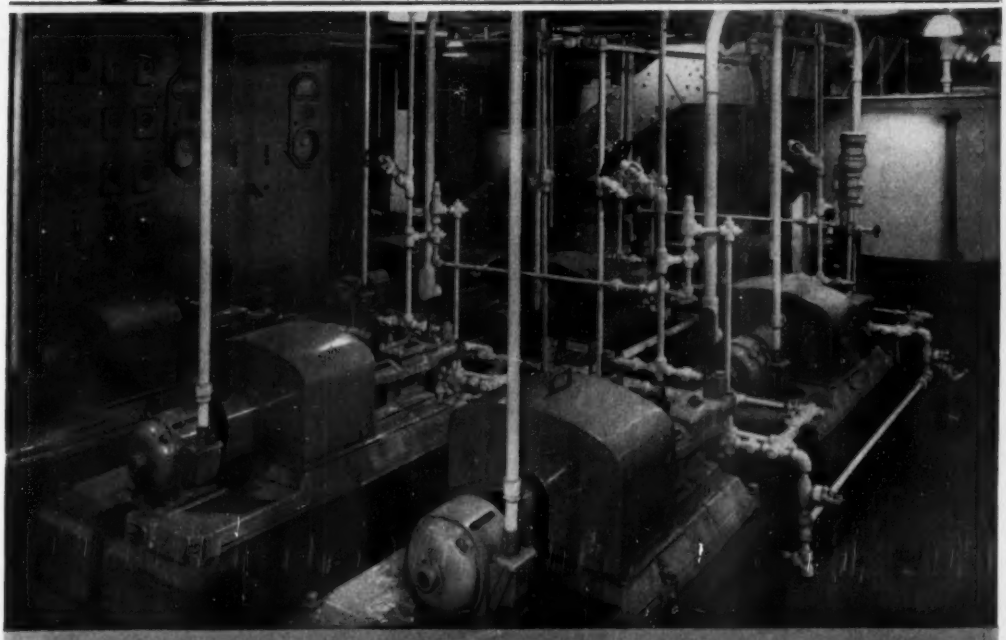
The Marley Company, Inc.

KANSAS CITY 15, KANSAS

MORE POWER

MECHANIZE Your Boiler Water Conditioning!

- IMPROVE HEAT TRANSMISSION
- SAVE FUEL
- REDUCE COSTLY SHUTDOWNS FOR REPAIRS AND CLEANING



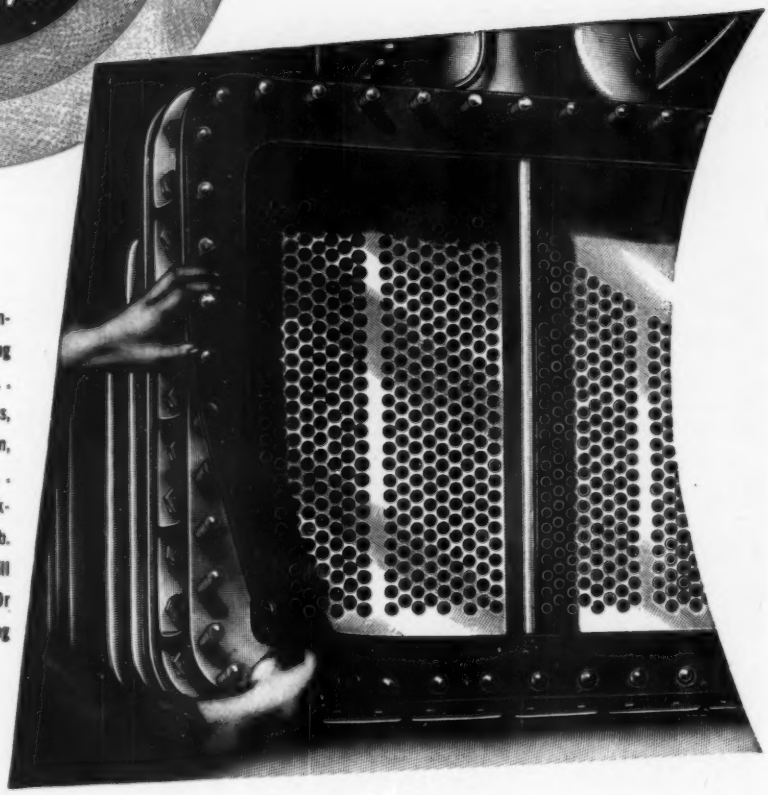
%Proportioneers, Inc.% furnishes complete chemical feeding systems for continuous automatic water conditioning. We supply systems to engineers' specifications or where required can adapt our controls to existing equipment — We will gladly assume responsibility for the complete chemical feeding system including control panels, chemical tanks, dissolvers and all other units required. Write for Brochure SM-9020.

% PROPORTIONEERS, INC. %

Write to %PROPORTIONEERS, INC., 385 Harris Ave., Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH R/M



Gaskets like this for Freon condensers may not be your packing problem, but whatever it is . . . high pressures, high temperatures, chemicals, refrigerants, petroleum, food or other products . . . Raybestos-Manhattan has a packing or gasket designed for the job. Your nearby R/M distributor will help you solve your problem. Or write for the new R/M Packing Catalog.

R/M

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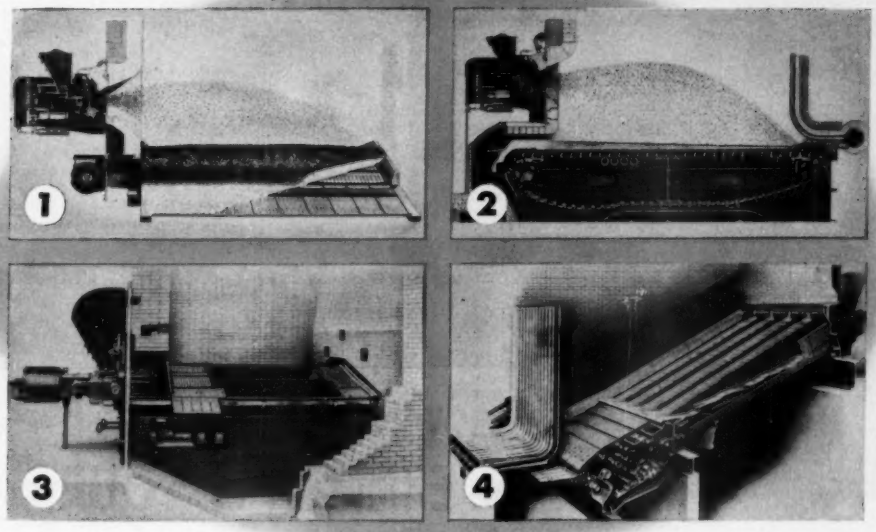
RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Powdered Metal Products • Bowling Balls



High Efficiency... Ease of Operation

in the Stoker Type That Meets Your Need

1. *Centrafire with Link-Grate*
The Centrafire with Link-Grate is a unique spreader-type stoker for medium capacities to upward of 50,000 pounds of steam per hour. Fuel feed is continuous. Link-Grates move the burning fuel toward the side walls. Refuse is discharged without reducing load or losing steam pressure.

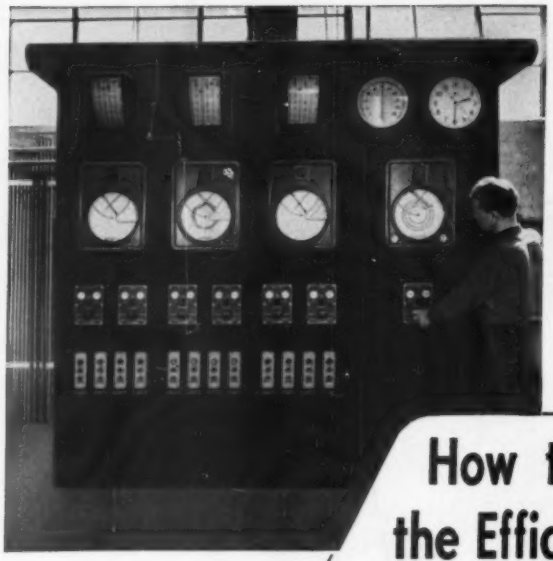
2. *Centrafire with Traveling Grate*
A spreader-type stoker with traveling grate for the larger Central Station and industrial plant. Maximum capacity upward of 350,000 pounds of steam per hour. Same fuel feeding and distributing mechanism as Centrafire with Link-Grate. Forward-moving traveling grate for continuous discharge of ash.

3. *Link-Grate Single-Retort Stoker*
The Link-Grate Single-Retort Underfeed Stoker is an economical means of burning many coals for the small installation. Link-Grate motion maintains an active, porous fuel bed for efficient coal burning with a minimum of attention.

4. *Link-Grate Multiple-Retort Stoker*
A clean stack and outstanding efficiency are characteristic of the Link-Grate Multiple-Retort Underfeed Stoker for the larger installation where fuel is suited to underfeed type firing. Link-Grate motion and continuous ash discharge permit heavy, continuous loads.

Call your nearby Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa., for complete information. J-50523

YOU CAN BE SURE... IF IT'S
Westinghouse
STOKERS



These Bailey Boiler Controls at the Chicago Pneumatic Tool Company's new plant in Utica, N. Y. insure efficient operation of three 25,000 lb per hour, 100 psi, spreader stoker-fired boilers

How to INCREASE the Efficiency of YOUR BOILER-ROOM DOLLAR

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better "boiler-room investment" efficiency —for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

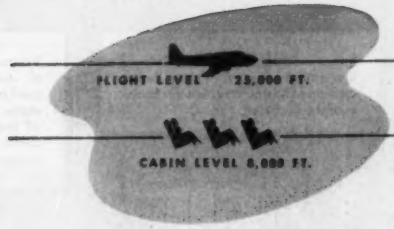
A-111-0

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS



In modern air-liners you breathe comfortably at altitudes of 25,000 ft., because your cabin is "Pressurized" — air pressure inside the plane is kept at or near normal sea level pressure.

Boilers, too, "breathe" easier when their combustion air is "pressurized" using forced draft

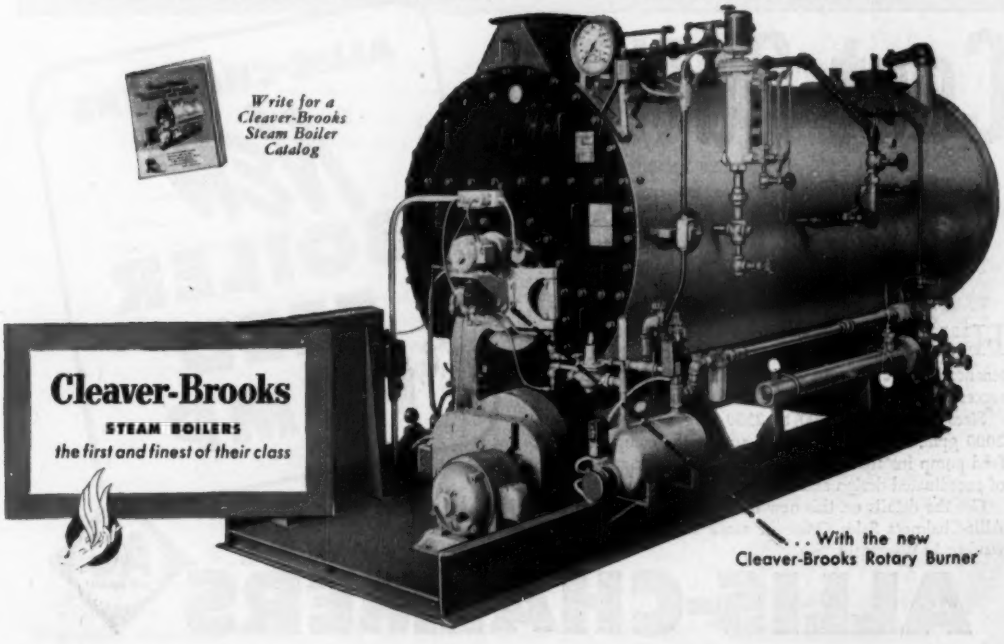
Cleaver-Brooks experience with thousands of steam boilers, of the self-contained type, has conclusively proven these operating advantages of forced draft:

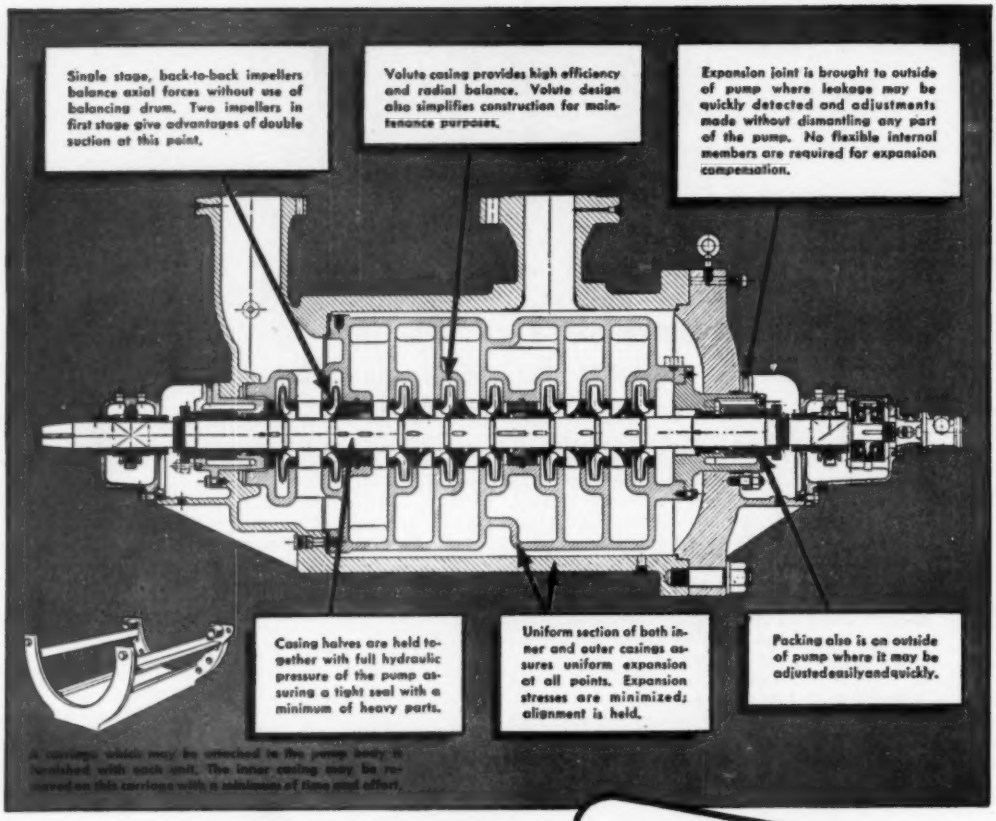
- — because atmospheric boiler-room air is constant in temperature and therefore in density, the weight of air delivered for combustion by a forced draft fan is also constant and always gives proper air-fuel ratio (CO_2) resulting in maximum efficiency and freedom from combustion problems.
- — the electrical load, or power requirement, of a forced draft fan is at a minimum, because the fan handles a lesser volume of air.
- — low fan maintenance and longer fan life with forced draft fans since they operate with cool, clean boiler room air — no problems with high bearing temperatures and corrosion.
- — air is under pressure in the combustion chamber of a forced draft boiler, with no possibility of "diluting" air entering the chamber. Maximum boiler efficiencies are always attained when head plates and casings are tight.
- — lower initial fan cost, better space arrangement, and better appearance are gained because forced draft fans are considerably smaller.
- — casings for forced draft fans are cool — require no insulation — contribute to safer operation and cooler boiler rooms.

Forced draft is one of many reasons why you get a greater return from your investment in a Cleaver-Brooks boiler — a boiler of foremost quality in every detail and with many immediate and long-range cost-saving features. Cleaver-Brooks self-contained boilers are available for oil, gas, combination oil and gas firing — 15 to 500 hp., 15 to 250 lb. p.s.i.

CLEAVER-BROOKS COMPANY
362 E. Keefe Ave., Milwaukee 12, Wis.

Write for a Cleaver-Brooks Steam Boiler Catalog




Single stage, back-to-back impellers balance axial forces without use of balancing drum. Two impellers in first stage give advantages of double suction at this point.
Volute casing provides high efficiency and radial balance. Volute design also simplifies construction for maintenance purposes.
Expansion joint is brought to outside of pump where leakage may be quickly detected and adjustments made without dismantling any part of the pump. No flexible internal members are required for expansion compensation.
Casing halves are held together with full hydraulic pressure of the pump assuring a tight seal with a minimum of heavy parts.
Uniform section of both inner and outer casings assures uniform expansion at all points. Expansion stresses are minimized; alignment is held.
Packing also is on outside of pump where it may be adjusted easily and quickly.

Cost Cutting Features

ALLIS-CHALMERS

NEW BOILER FEED PUMP

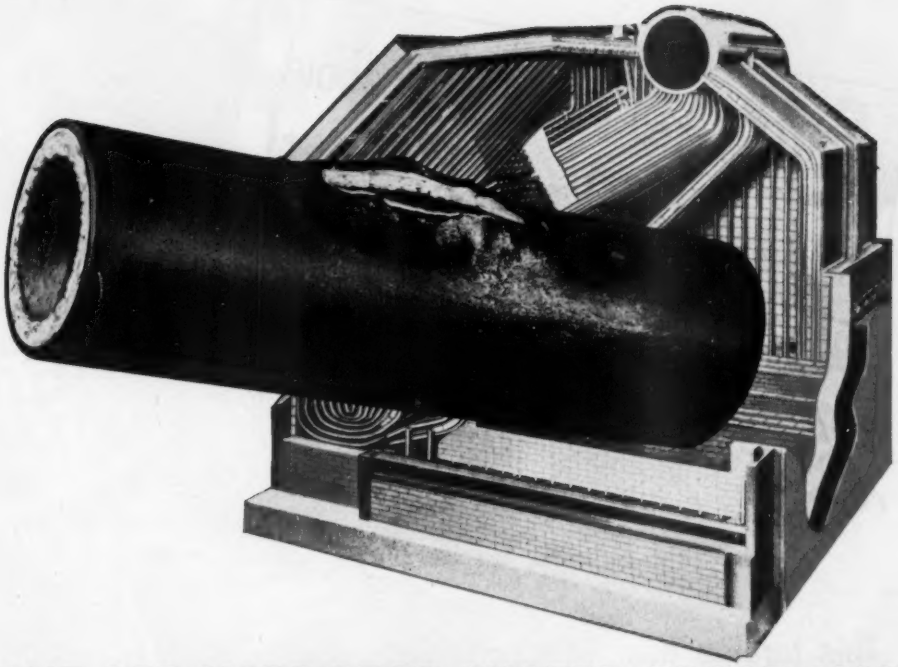
HERE IS A PUMP designed to meet the needs of the newer high pressure boiler plants. Efficiency is high, maintenance is low and every design feature has a long record of successful application to boiler feed service.

Sizes range from 1200 to 2500 psig and from 300 to 2000 gpm. Allis-Chalmers can supply the complete boiler feed pump installation including pump, motor and control, of coordinated design and manufacture.

Get the details on this new boiler feed pump from your Allis-Chalmers Sales Office or write Allis-Chalmers, Milwaukee 1, Wisconsin

A-3250

ALLIS-CHALMERS



DON'T LET IMPROPER WATER TREATMENT SABOTAGE YOUR BOILERS

This year, the weakest link in your production program may be *one* boiler tube! The loss of that tube will slow vital production . . . will take longer to replace . . . will cost more.

Modern, up-to-date water conditioning, such as the Drew System, prevents tube failures. Drew's continuing research, its study and investigation of *your* operating and water conditioning problems in its laboratories makes such prevention possible. Drew *insures* the performance of your water conditioning by its dependable and frequent testing and checking service.

That's why Drew is one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew's specialized service. Do the same. Consult the nearest Drew engineer or write for further information.

Send for the new, illustrated DREW ORGANICS Folder describing the use of organics in modern Boiler Water Treatment. Write today.

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Nationwide Service in Boiler Water and Cooling Water Conditioning

Facts you should know about De Laval turbines!

This turbine has two traffic cops...

that give you double protection against overspeeding. The normal speed governor and overspeed governor are entirely separate. A sticky governor valve can't possibly jeopardize the operation of the overspeed governor and trip.

You can elect the governor that meets your requirements!

We have eight candidates for the job, so take your choice:

Mechanical Shaft governor with smooth-acting, long-wearing "rocking chair" action.

Vertical Mechanical governor geared to shaft for speeds above 4500 rpm.

Hydraulic Governor. Direct acting orifice-type for high speeds and/or wide range of speed adjustment.

Hydraulic Oil Relay for close regulation or for supplying extra power for valve movement.

Flyweight Oil Relay for close regulation such as encountered in synchronous generator drives.

Pressure Controls for constant pressure or differential pressure regulation of pumps, blowers, etc.

Speed Changers, manual or remote control by electric motor drive.

Auxiliary Trips to shut off steam in the event of low pressure in the lubrication system or undue rise of back pressure. Also can be solenoid operated for remote or manual trip, or for inter-connection with the driven machine or any emergency system.

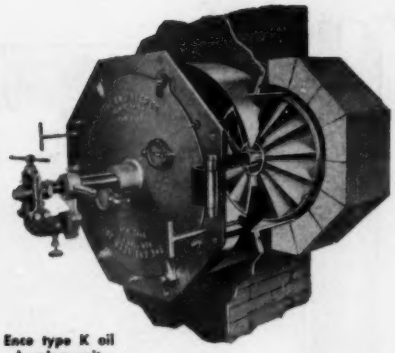
Send for Catalog 82-19R

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

50th DE LAVAL Anniversary

ENCO
OIL and GAS
BURNER UNITS



Enco type K oil burning unit

High load or low, you can count on completely uniform combustion and greater fuel economy with the Enco Type K Oil and Gas Burner Unit. It is flexible three ways . . . (1) designed for use with either oil or gas—or both, (2) flexible where steam demands swing sharply and (3) can be operated by either natural or forced draft.

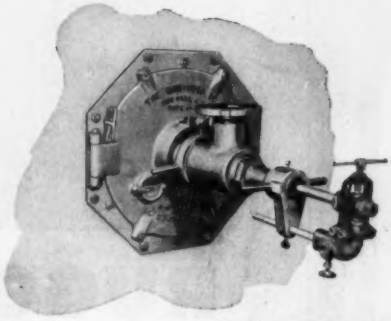
ENCO BURNER UNITS ARE MADE in many sizes to suit all capacity requirements.

Enco Interchangeable Atomizers

Wide Range Mechanical—Capacity range of 10 to 1. Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

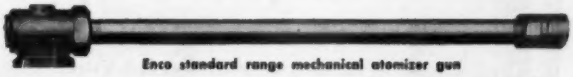
Steam or Air—Capacity range of 10 to 1. Controlled by manual or automatic pressure regulation.

Standard Range Mechanical—Available in all sizes to suit load and capacity requirements.

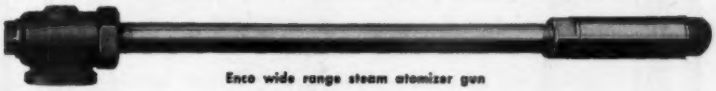


Enco type K gas-oil burning unit

BULLETINS ON REQUEST
WRITE TODAY

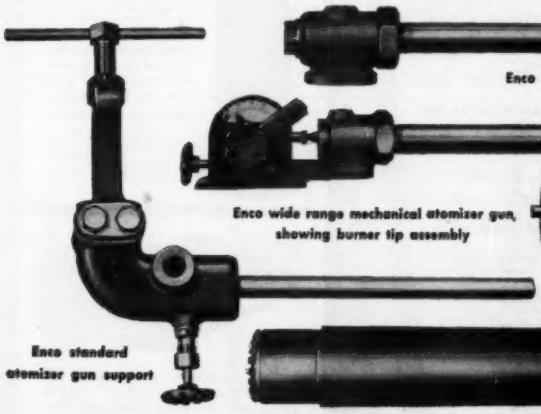


Enco standard range mechanical atomizer gun



Enco wide range steam atomizer gun

Enco wide range mechanical atomizer gun, showing burner tip assembly



Enco standard atomizer gun support

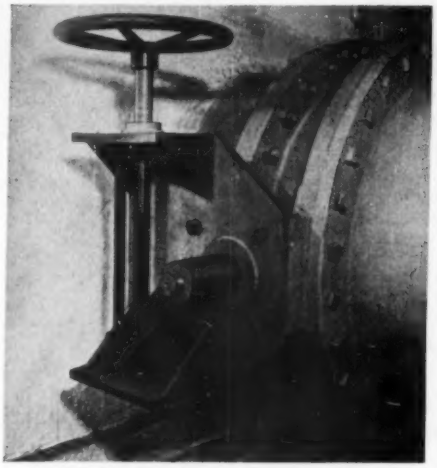
Enco gas burning gun

THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: F. J. RASKIN, LTD., 4220 ISERVILLE ST., MONTREAL 26 P.Q.

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



RUGGED Simplicity

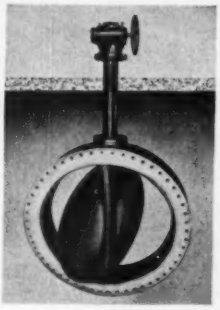
Correctly engineered mechanically and metallurgically, all body assemblies of R-S Valves equal or exceed A. S. A. standards in every detail. These valves are designed and constructed for rugged service and provided with such safety factors that they will exceed service expectations as well as reduce pumping and blower costs.

Consider also the few working parts, greater control rangeability, the self-cleaning feature and the fact that R-S Valves are readily adapted to automatic operation. Know the rugged simplicity of R-S Valves, and get the most from your valve investment.

District offices are listed in telephone directories as, "R-S Products Corp'n Valves".

R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary

No. 782—Heavy Duty Rubber Seated Wafer Type Valve with 5° angle seated vane and enclosed gear reduction drive. Gland can be removed and stuffing box repacked without removing prime mover.



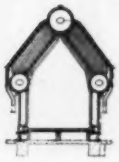
No. 739-740—Sixty-inch, 50-pound Heavy Duty Valve with gear reduction drive and handwheel for handling water at 40 psig. Vertical valve stem enclosed in steel pipe support. Thrust bearing absorbs vertical load.

No. 730—R-S Heavy Duty Floor Stand for rugged service in connection with any standard R-S handwheel operated valve.

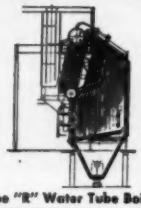
No. 767—A 3-Way Valve (Two 24-inch 125-pound Cast Iron Valves bolted to 125-pound American Standard Tee). Electric motor operated by cross linkage. Automatic declutching handwheel for emergency operation.

If you need steam you need a Wickes steam generator

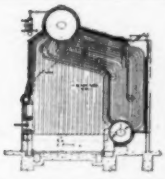
WICKES



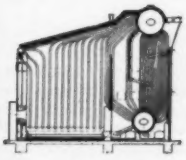
"A" Type Water Tube Boiler



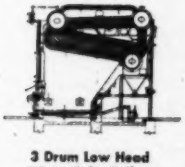
Type "R" Water Tube Boiler



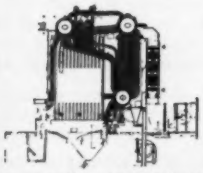
Type-S 2 Drum Boiler Series S1



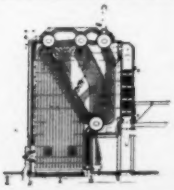
2 Drum Water Tube Boiler



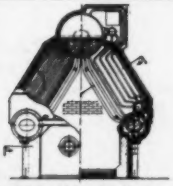
3 Drum Low Head Water Tube Boiler



3 Drum "B" Type Water Tube Boiler



4 Drum Water Tube Boiler



N_3 Oil Fired Marine Service Water Tube Boiler

Wickes Steam Generators are in constant daily service in thousands of installations throughout the world. Wickes can fill your exact requirements for boilers of any type up to 250,000 lbs. steam per hour and 850 psi. • Wickes Boilers are engineered for use in oil, chemical, paper and many other industrial uses as well as marine service. Our knowledge of steam generation is available for your consultation, without obligation. Descriptive literature available upon request.

• Remember — if you need steam you need a Wickes Steam Generator.

THE WICKES BOILER CO.

SAGINAW, MICHIGAN

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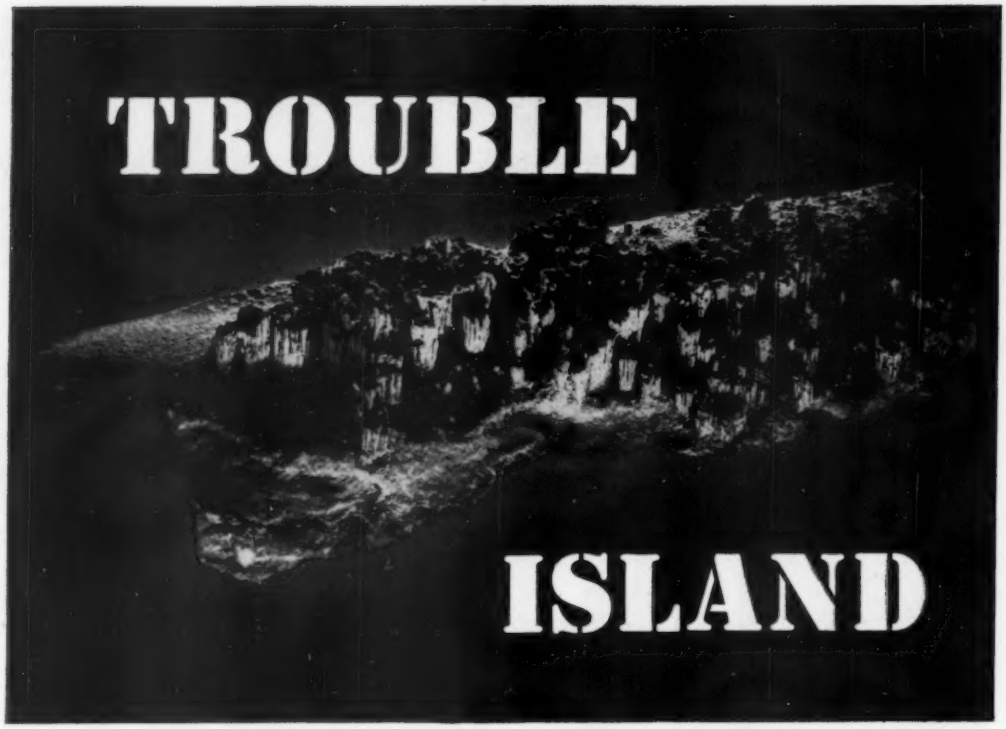

Photo is of a condenser-tube scale sample, about eight inches long. Solid scale is approximately ¼-inch thick, with "spires" ranging up to ⅜-inch height.

FIFTEEN years ago, this small island of trouble was part of a much larger open-box condenser problem at a refinery. Cooling water, running over 200°F. at outlet, contained 30 grains per gallon hardness and 20 parts per million iron. Tubes scaled heavily and rapidly without chemical inhibitor. Even with the best inhibitor then known, results were as illustrated above: partial inhibiting action creating the "spires" or forest-like deposits on tubes.

Considering this a challenge, Nalco sent a Doctor of Physical Chemistry—an expert water technologist—to the refinery. His weeks of work on the spot led to basically different treatment with new chemicals which cleaned up the condenser and kept it clean. Further Nalco research and development of chemical inhibitors has since enabled cooling systems to operate without scale or corrosion *with water hardnesses as high as 200 grains per gallon.*

Point is this: neither Nalco nor anyone else had an answer to scaling in that condenser. Nalco put the necessary brains to practical use and *got results* . . . benefiting, in the long run, not only that particular refinery, but every user of cooling water.

Whether your water treatment problem is unique, or stubborn plant-run, you will get prompt, decisive action from Nalco in the direction of positive results. Write or telephone today.

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Canadian inquiries should be addressed to
Alchem Limited, Burlington, Ontario

THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail

INSTRUMENTS AND CONTROLS

101 Pneumatic Transmission Systems—Illustrated Instrumentation Sheet 9.1-4, 4 pp, describes a pneumatic transmitter system for centralizing records of pressure, flow and temperature and affording greater safety in central station operation. Explains principles of pneumatic transmission; discusses location of transmitter and receiver, equipment required, long distance pneumatic transmission, and system advantages. Gives specifications for a recording pneumatic receiver. Industrial Div., Minneapolis-Honeywell Regulator Co.

102 Tachometers—Resonant reed tachometers for hand use or permanent mounting, which require no contact with moving parts, are described and illustrated in 16-pp Bulletin 31 complete with ranges, other ordering information. Also provided are specifications and aids for selection and application of various ranges and types. Price list included. James G. Biddle Co.

103 For Quick Current Measurements—Illustrated Form TT-5025 is a revised 8-pp bulletin covering manufacturer's Tong Test ammeters which can be used for measuring current in both a-c and d-c lines. Tells what these lightweight, low priced ammeters can do and discusses their features. Actual size illustrations show typical scale ranges. Gives information on standard ranges and how to select an instrument, also discusses range lowering and tests with high voltage circuits. Includes prices. Columbia Electric Mfg. Co.

104 Combustion Control Case Histories—Here are five new bulletins each containing an illustrated report of a specific experience with combustion control, specific boiler conditions existing at the plant, how the control system operates, and results obtained with automatically controlled combustion. A selector guide, schematic drawings and photos are included. The Hays Corp.

105 Manual on Watthour Meters—A comprehensive presentation of the fundamentals of alternating-current metering, 48-pp Bulletin GET-1846 is fully illustrated with charts, diagrams and photos. It shows how electric energy is measured; describes the operating principles of a-c watthour meters; and explains techniques involved in the use, testing and maintenance of meters. A compendium of information, the brochure can be used as a reference for the power engineer, or as an aid in teaching proper application and maintenance of a-c watthour meters. Meter and Instrument Divs., General Electric Co.

106 Time Proportioning Relay—Illustrated Specification Sheet 188 describes manufacturer's Electr-O-Pulse Relay which provides time-proportioning control by variation of the on-off time ratio of a contacting device and has automatic reset. Discusses construction and operational details and features, also cycle time setting, approach rate, manual control. Dimensions included. Industrial Div., Minneapolis-Honeywell Regulator Co.

107 Electronic Indicator—Illustrated Pamphlet 625/B, 6 pp, explains operation of an electronic device for measuring both static and rapidly alternating forces, pressures, distances, vibrations, etc., and having wide application in diesel engines, gasoline engines and compressors, and pumps, as well as in measuring vibration and oscillation of machine parts, torsional oscillation of shafts. Morgans Bang & Co.

108 Thermocouple and Pyrometer Accessories—A new edition of company's accessory catalog, 36-pp Bulletin 7126 lists additional items and contains new data on proper application and use of thermocouples. Well illustrated, covers assembled thermocouples, thermocouple wires, extension wires, protection tubes, insulators and accessories for the full range of industrial pyrometer application. New technical information and installation sketches have been added to "Users' Manual" section containing engineering data on modern practices in pyrometry. Also included are tables of calibration data for commonly-used metal and rare metal thermocouples. The Bristol Co.

MECHANICAL POWER TRANSMISSION

109 New Speed Reducers—The single reduction units described and illustrated in Bulletin A602 are recent additions to company's Torque Arm reducers previously available only as double reduction units. Important advantages and special features listed to show how they provide a more flexible, more economical means of speed reduction. Reducers come in four output speeds from 115 to 230 rpm, in capacities to 27 hp. Selection tables, dimensions and recommended V-belt drives are included. Dodge Mfg. Corp.

110 Variable Speed Control—Twelve-pp Bulletin G-100, describes basic operating principle of company's variable speed drives and contains representative rating tables and dimension drawings. Covers capacities from ½ to 87 hp with stepless speed changes within ratios from 3 to 1 to 16 to 1. Presents three basic units, a variable speed transmission, Vari-Speed Motodrive and motor pulley and manual, automatic controls. Reeves Pulley Co.

111 Chain Hand Book—An authoritative 52-pp booklet, Catalog ARC-51 is packed with suggestions on how to install, maintain and operate roller chain. Tells how to plan chain drive layouts; offers valuable hints on lubrication and roller chain selection. Also contains length conversion tables, horsepower rating charts, list prices with specifications for all types of roller chain and extended pitch conveyer chain. Atlas Chain and Mfg. Co.

VALVES

112 Water-Pressure Reducing Valve—Six-pp Bulletin W-3 shows general arrangement of company's cushioned water pressure reducing valve and reducing pilot valve, along with a detailed list of parts.

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installation, operation, adjustment, servicing and specifications are described. Also provided are tables showing dimensions, shipping weights and materials. Golden-Anderson Valve Specialty Co.

113 Double-Closure Bin Valves—Circular 254-A on self-opening bin valves for handling lump and fine materials, describes and illustrates their double closure designed to make them dust tight and dribble proof. Includes prices, dimensions. Stephens-Adamson Mfg. Co.

114 Steam Capacity Chart—Letter size and punched for filing in binder, this helpful chart is for determining steam capacity required from safety valves to give 100 per cent protection in case of pressure reducing valve failure. Marine & Industrial Products Co.

ELECTRICAL

115 Standardized Bushings—A new standardization program which replaces more than 1600 types of transformer and circuit breaker bushings with only 38 standard bushings of maximum usefulness is announced in 12-pp Bulletin GEC-713. Standardization on fewer bushings has resulted in savings in production, routine engineering, and manufacturing, and because of this, prices for standard bushings are 10 per cent less than for similarly-rated non-standard types. Standard bushings listed include transformer and circuit breaker types rated from 15 kv to 230 kv, 1200 amp and below. Transformer and Allied Products Div., General Electric Co.

116 Safety Switch—This 24-pp booklet explains why company's front-operated switch offers cool operation, increased safety, and easy and economical maintenance, illustrating these and other advantages by sketches and photos. Comparison charts show how these switches compare with competitive lines on design and operating features. Federal Electric Products Co.

117 Buyers' Manual on Motors and Control—Fifty-pp Catalog GEC-1060 presents buying information on a carefully selected group of motors, motor starters, control accessories and electronic control. Ratings listed are those most frequently required. Excellent data on proper selection of this equipment is provided as well as full descriptions, dimensions, ratings, prices. Fully illustrated. General Electric Co.

118 Check List for Lighting Equipment—Four-pp Bulletin 1060 tells how to specify RLM labeled lighting equipment. Features an easy-to-use chart which shows whether or not a certain type of unit is RLM certified, names of manufacturers of RLM units of type and size desired, and lighting units not yet certified, but in process of being tested. RLM Standards Institute.

119 Synchronous Generators—Bulletin GEA-5470, 4 pp, covers high-speed synchronous generators for standby, portable, and prime-source power in ratings from 1,875 to 50 kva with frequencies of 60 and 400 cycles. Four designs are described; externally-regulated, self-regulated, and packaged-regulated 4-pole synchronous generators, and high-frequency 14-pole synchronous generators. Well illustrated with product pictures and cutaway and exploded-view photos, bulletin lists construction features and includes a comprehensive table of ratings. General Electric Co.

ENGINES, GENERATORS

120 Turbine Generators—Bulletin H-13, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical turbine condenser installation arrangement. Dimensions and weights of standard units are tabulated. Elliott Co.

121 Diesels and Machinery—Bulletin 157, 28 pp, gives fully illustrated design data an company's two- and four-cycle diesel engines, gasoline engines, as well as cone crushers and screens, hoists, air and gas compressors and other equipment. Various industrial applications are shown. Booklet also gives an interesting historical background of manufacturer and a description of company plants. Nordberg Mfg. Co.

122 Two-Cycle Diesels—Catalog 6 SA-12, 36 pp in color, describing a complete line of two-cycle diesel engines for application in industrial and other fields, covers single and multiple engine units from 2 to 24 cylinders with power ranging from 22 continuous to 780 intermittent horsepower. Contains data on manufacturer's two-cycle design and interchangeability of parts; a power selection chart covering 57 standard power take-off and seven torque converter models; application illustrations and outline of service facilities. Detroit Diesel Engine Div., General Motors Corp.

123 Welded Steel Radiators—Catalog 1651, 4 pp, covers company's Mono-Weld radiators for heavy-duty gas, gasoline and diesel engine cooling, shows design features and accessories for both one-piece and sectional-type cores—the former available in sizes capable of dissipating 70,000 to 800,000 Btu per hr under standard conditions and the larger sectional-type core units, from 940,000 to 2,250,000 Btu per hr. Young Radiator Co.

WATER CONDITIONING

124 Slurry Type Softener—Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for flow preparation is mechanical, explaining and illustrating flow circuit. An excellent question-and-answer appraisal of system is included, and equipment is pictured. Worthington Pump and Machinery Corp.

125 Ion-Exchange Conditioners—Water conditioning equipment of the ion-exchange type is described in illustrated Bulletin A, 8 pp. Information covers softeners, hydrogen zeolite, de-ionizers, and company's newly developed mixed-bed de-ionizer, giving specifications on packaged-type units available for flow rates to 1800 gal per hr. Illinois Water Treatment Co.

PAINTS, COATINGS

126 For Better Surface Protection—This is a recently published collection of test data and application information on company's new Tinallium Pro-Tex-It, a non-drying, paste-type preservative developed for use on all metals, woods and concrete mixes for protection against weathering conditions, acids, alkalis, fumes, chemicals and other destructive agents. Discusses fire-resistance, non-staining and non-toxic qualities, other features. American Sand-Banum Co., Inc.

127 Paints to Resist Corrosion—This new 8-pp illustrated bulletin is devoted to company's line of anti-corrosive paints. Discusses their sub-oxide of lead base and other technical properties and points out savings in time and money afforded by the use of these rust-inhibitive coatings. Describes primers, finishing coats and single coats available; tells how to apply them. Also discusses painting of galvanized structures. Subox, Inc.

SCALES

128 Automatic Weighing Scale—This 6-page illustrated bulletin introduces an automatic weighing scale for coal and other bulk materials, stressing weighing accuracy,

(Continued on page 134)

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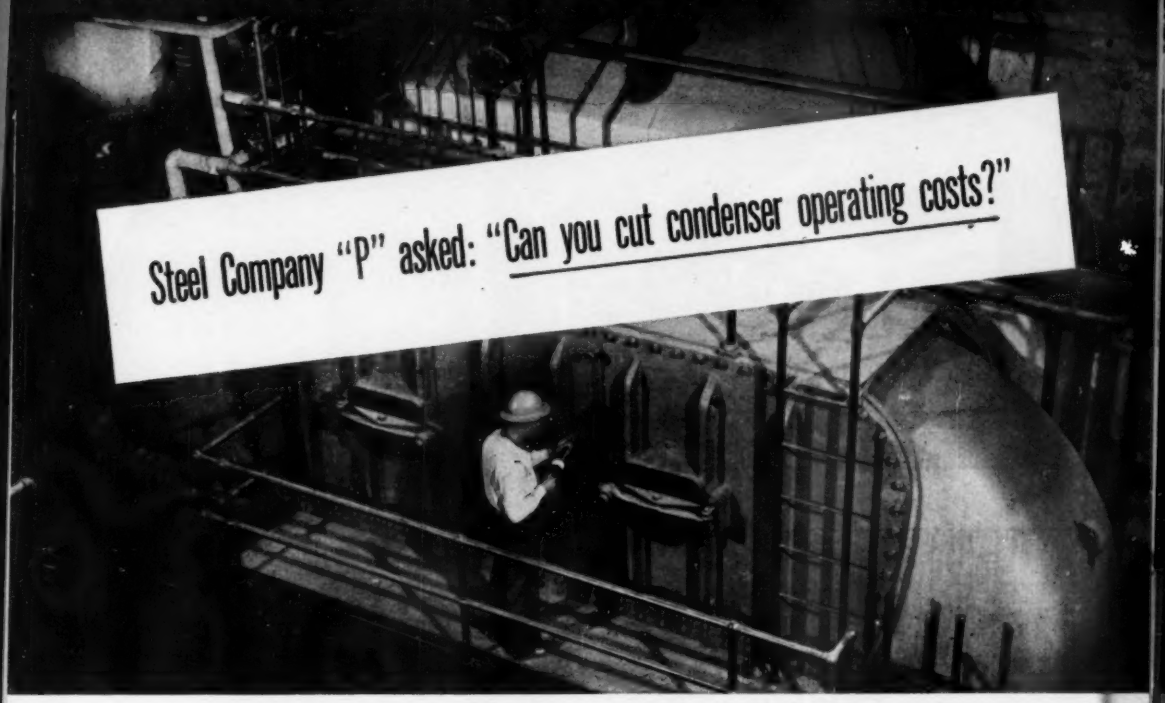
DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



Steel Company "P" asked: "Can you cut condenser operating costs?"

Dowell Service saved $87.92 in steam per day!

Dowell Service was used by a major steel company to clean a large turbo blower condenser. After the cleaning, operating figures showed a saving in steam of 8000 lb. per hour or a dollar saving of $87.92 per day. At this rate, *Dowell Service paid for itself in 5½ days!*

There are many places in every industrial plant where Dowell Service can be used to cut operating costs. Wherever deposits on the surfaces of condensers, boilers, heat exchangers, water lines and other equipment are stealing power, Dowell Service can show money-saving results.

Dowell Service has another prime advantage for the maintenance engineer. *It is fast!* Because cleaning is done chemically, time-consuming dismantling is eliminated. Dowell engineers fill the equipment with liquid solvents that go wherever steam and water flow. These solvents are designed to remove deposits quickly, efficiently and economically.

Do you have a cleaning problem, too . . . a place where deposits are causing a maintenance headache? Call Dowell. Skilled cleaning engineers are available for consultation at no obligation.

Other recent Dowell jobs:

In a large textile plant, the heating time required in kier heaters was cut one-third, following cleaning with Dowell Service.

•

Houdry catalyst cases cleaned by Dowell Service for a large refinery showed all tubes to be practically metal clean and orifices opened.

•

Thirty-three year old water well, cleaned by Dowell Service, showed increase from 64 to 130 g.p.m. with drawdown decrease of 27 feet.

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Richmond 19	St. Louis 8	Ft. Worth 2	Midland, Texas
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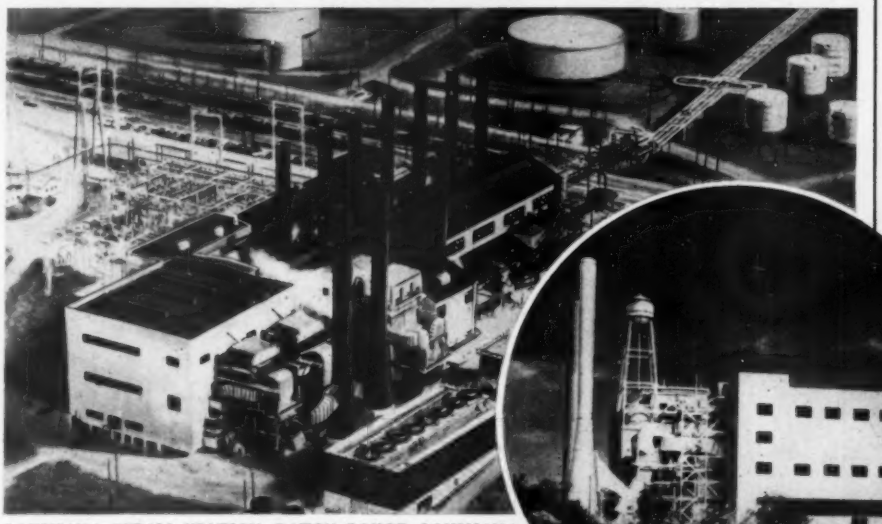
Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

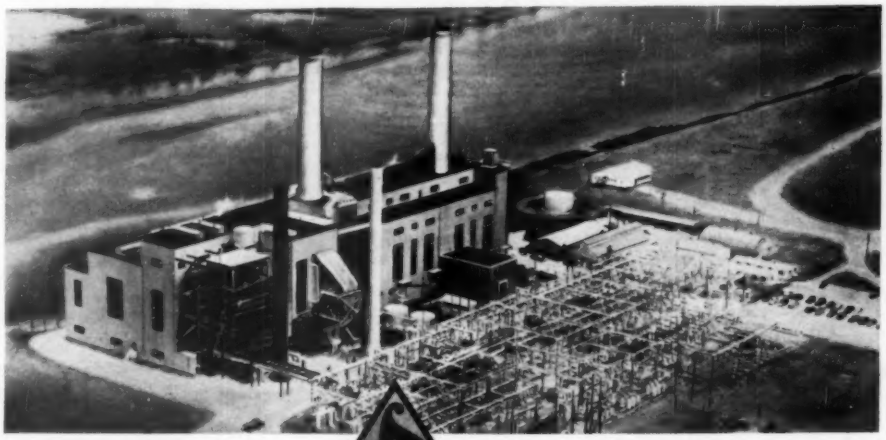


LOUISIANA STEAM STATION, BATON ROUGE, LOUISIANA

RIVERSIDE STATION, LAKE CHARLES, LOUISIANA

Magnet for Industry

Industry has been drawn to the Louisiana and East Texas area of Gulf States Utilities Company by a plentiful power supply. Recently completed additions and work in progress will bring the total generating capacity of the system to over 600,000 kw. With the exception of 35,000 kw partially installed at Riverside when it was acquired by Gulf States Utilities Company, all of this capacity has been designed and constructed by Stone & Webster Engineering Corporation.



NECHES STATION, BEAUMONT, TEXAS

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

SILICA-FREE BOILER WATER without Evaporation . . .

From Any Raw Water Supply

The AMBERLITE deionization process gives you the water you *need* from the water you *have*. Regardless of water analysis, you can obtain highest quality boiler-feed water, *without* evaporation. Total ionized solids can be reduced to less than 0.1 p.p.m. Silica content, CO_2 content and hardness are virtually zero.

You'll cut costs, too, with AMBERLITE deionization. Equipment cost is small compared to evaporators. Operating cost is lower. Corrosion of piping is reduced through removal of CO_2, which is never completely accomplished by evaporation. An adequate supply of conditioned water is assured despite wide variation in the quantity required.

For improved water conditioning at lower cost, choose either an AMBERLITE multiple bed installation or a single bed unit. For further details, write today for your copy of our new four-page bulletin on AMBERLITE Ion Exchange Resins. Then discuss AMBERLITE deionization with your consulting engineer or water conditioning equipment manufacturer. He will be glad to help you select the right combination to suit your specific needs.

Newest word in water-treating

MONOBED DEIONIZATION

One pass through one column of AMBERLITE mixed anion and cation exchangers can transform raw water into deionized, silica-free water. Ask for our new 12-page booklet, "Monobed Deionization."

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square Philadelphia 5, Pa.

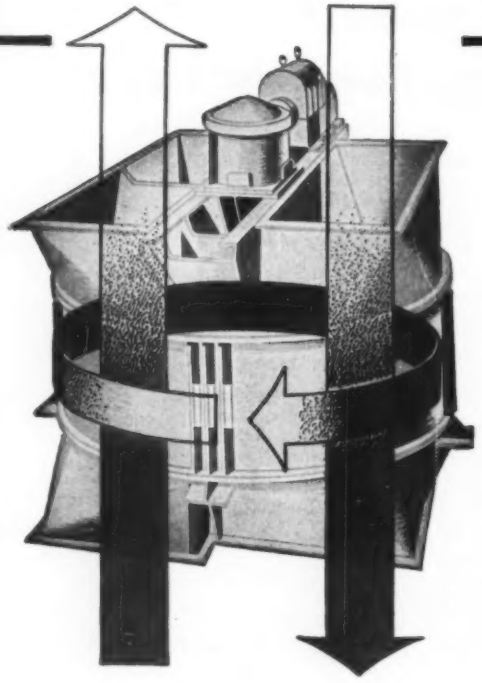
Representatives in principal foreign countries

AMBERLITE is a trade-mark, Reg. U. S. Pat. Off. and in principal foreign countries.

more than 200,000,000 lbs/hr of post-war steam generating capacity

equipped with *Ljungstrom*

AIR PREHEATERS



Here indeed is impressive evidence of the wide acceptance of the Ljungstrom air preheater. Since the war the total capacity of steam generating units equipped with Ljungstrom air preheaters, installed, under construction or on order in industrial and utility plants throughout the country comes to well over 200,000,000 lbs of steam per hr.

The reasons for the steadily increasing preference for the Ljungstrom air preheater are simple enough. The continuous regenerative counterflow principle assures maximum heat transfer with minimum weight and size. Flexible and compact, it may be used in a wide range of applications. Its proven reliability and low maintenance eliminate costly shutdowns.

If you are planning to build a new plant or modernize an old one, investigate the possibilities of the Ljungstrom. The specialized experience of Air Preheater engineers is at your disposal, to aid in effecting the most economic heat recovery from flue gases.

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

THE AIR PREHEATER
60 EAST 42d STREET • NEW YORK 17, NEW YORK
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POINTS TO CHECK ✓

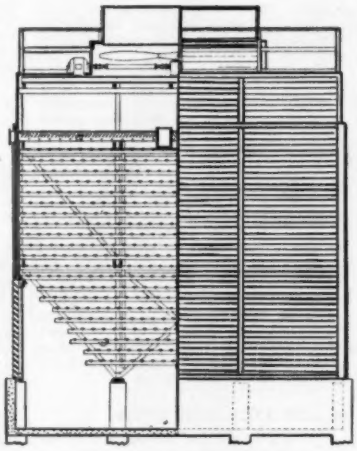
IN YOUR COOLING TOWER INVESTMENT

Here's what you get with a *C.H. Wheeler* Cooling Tower

✓ **GUARANTEED COOLING RESULTS**—Names of installations near you sent on request. Repeat orders prove customer satisfaction.

✓ **GUARANTEED WIND-SAFE**—Standard construction for 100 miles per hour— (75 mph is hurricane velocity).

✓ **TWO TENTHS OF 1% DRIFT LOSS**—Accurately placed Herringbone Drift Minimizers save on make-up water.



✓ **ADVANCED DESIGN PLASTIC FANS**—on large towers pioneered by C. H. Wheeler—adjustable pitch blades—20-1 safety factor.

✓ **MOST EFFICIENT WATER BREAK-UP**—Wood fill arranged for best combination of wetted surface and water drop surface to speed cooling.

✓ **CASINGS CONFORM**—to architecture—to fire codes—may be many materials, including redwood, asbestos cement board, masonry, brick, properly painted steel, etc.

✓ **NON-COLLAPSING FILL**—Rugged 2" x 2" redwood members sawed diagonally—last the life of tower.

✓ **NON-CORROSIVE ELEMENTS**—Fill is slot-fitted; no nails. Nuts, bolts, etc., furnished in non-corrosive metals. Plastic fan blades.

✓ **EASE OF ACCESS**—into all parts of tower, *including the cooling space,* for regularity of maintenance.

✓ **ENGINEERED FOR THE CLIMATE**—50 years of successful experience in building for arid, tropical and cold areas, including severe icing conditions.

✓ **CUSTOM BUILT**—Sure to satisfy your specific requirements.

✓ **INDUCED, FORCED, OR NATURAL DRAFT**

✓ *LITERATURE MAILED ON REQUEST*

C.H. Wheeler OF PHILADELPHIA

VACUUM REFRIGERATION—COOLING TOWERS—HIGH VACUUM PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—STEAM CONDENSERS—STEAM JET EJECTORS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

C. H. WHEELER MANUFACTURING CO., 1802 SEDGLEY AVE., PHILADELPHIA 32, PA.

REPRESENTATIVES IN MOST PRINCIPAL CITIES

NEW EQUIPMENT NEWS

WHAT'S NEW? On these pages the Editors summarize the outstanding industrial developments of leading manufacturers who will supply you, free of charge, the bulletins or other information desired. For ease in making requests use the no-obligation, postage-paid card pages 37-38.

1—RUBBER LINED VALVE

Is developed for emergency gas or liquid shut-off service

Heavy-duty Valve No. 763 is made of cast iron and is rubber seated. With the angular seating vane for wedge type closure, the rubber is compressed around the periphery of the vane to give positive shut-off even around the shaft bosses, manufacturer explains, and this type of construction permits the use of an iron body valve in services usually calling for other materials. The rubber flanges are used to take the place of flange gaskets.

Valve is completely cycled and operated by a directly connected motor driven pump, sealed in oil. Hydraulic pressure raises the counter-weight for the open position. When valve is fully open, operating motor is cut off by integral switch. While operator is energized, current consumption drops to a minimum. Should current fail, oil operator is released, counter-weight drops and valve is closed. Valve action can be reversed. Sizes 2 to 72 in. are available. R-S Products Corp.

2—TRANSMISSION BELTING

Offers anti-slip, precision timing features, also quiet operation

The Gilmer Timing Belt, a rubber and fabric belt with teeth, is said to attain speeds to 16,000 fpm and operate more quietly than precision gears running in an oil bath. It can also be used as a functional part, such as a synchronized conveyor, as well as for transmitting power.

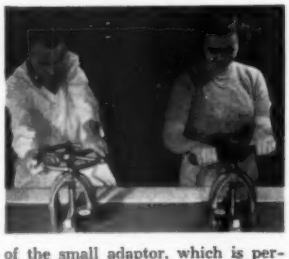
According to manufacturer, the belt needs no lubrication, but oil won't harm it. It is compact and speed ratios to 20:1 are possible with it; its extreme flexibility permits pulley diameters as small as ½ in. at 10,000 rpm even with a heavy load. Maintenance costs are declared low and initial cost of this belt may be lower than other types of drives because of smaller drive constructions. Belting can be manufactured in sizes and materials to suit applications. United States Rubber Co.

3—SMALL CROSS-ARM HANDLE

Of cast malleable iron with stem adaptor of drop forged steel

The cross-arm handle, demonstrated by the young lady, incorporates company's Impactor handwheel principle, described as a means for exerting greater effort to close a valve against high operating or test pressures, delivering more than twice the closing force of many handwheels. It is applicable to many of company's small valves, especially the 1¼, 1½ and 2 in. size Univalves of 1500 and 2500 lb sp, and the 2 in. hydraulic valves.

In operation, two lugs of the cross-arm handle strike equal blows simultaneously against opposite sides



of the small adaptor, which is permanently attached to the valve stem. Additional tools for applying force aren't required, company states. Edward Valves, Inc.

4—GLASS INSULATION

Is used to increase service life of cast-in-concrete reactors

The new insulation used in these reactors is capable of withstanding extremely high operating temperatures without deterioration, according to company engineers, because it is free of metallic impurities and provides more dielectric protection against turn-to-turn short circuits than many types of wound insulation used in reactor manufacture. It is also unaffected by moisture.

The improved air-core current-limiting reactors are also wound with cable consisting of continuously transposed conductors said to produce lower power losses and greater short-circuit strength. General Electric Co.

5—MECHANICAL PACKING

Is chemically inert, intended to withstand rugged conditions

Blue-Lon Style 320 is described as a highly resistant chemical packing for applications involving sulfuric acid, sulfurous chromic, nitric and other acids as well as caustics or alkalines. Made of Cape African blue asbestos, this packing is immunized by Teflon Suspensoid to give it greater acid resistance. A. W. Chesterton Co.

6—ION EXCHANGE RESIN

Is practical, low cost method of ridding water of malodorous sulfides

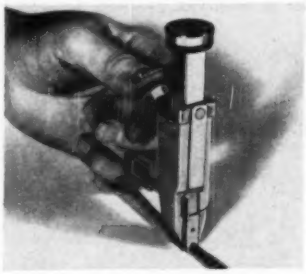
Success of this method of removing sulfides, which is readily adaptable to existing water softening equipment, is credited to the strongly basic character of Amberlite IRA-410, newest of company's high-capacity anion exchange resins. This new Amberlite is an amine type whose strong basicity permits adsorption of such weakly acidic constituents as H_2S. Its total exchange capacity of 25 kgr (as $CaCO_3$) per cu ft is reported to remain virtually unchanged over a pH range of 1 to 10. It is also described as highly resistant to such reagents as acids, bases, reducing agents and organic solvents.

If water hardness is high, softening and sulfide removal can be accomplished simultaneously by using Amberlite IRA-120 (sodium form), a strongly acid cation exchanger, in the same unit with the IRA-410. Because both resins can be regenerated with NaCl or $NaHCO_3$, the combined operation involves no additional cost in chemicals. Resinous Products Div., Rohm & Haas Co.

7—AUTOMATIC TACKER

Pocket sized, for quick stapling of wire, also hollow tube lines

Tiny as a toy, this new tacker handles braided, rubber-coated, single and double strand wire. Front and rear guides circle the wire and permit rapid



drawing around difficult angles or corners. It uses an improved staple, made in several colors, whose driving points penetrate plaster, composition board, hard and soft woods (with holding power to 64 lb) and company says it drives the staple to the required depth without injuring wire. The Heller Co.

8—VARIABLE SPEED MOTOR

Extra heavy duty type, available with ratings up to 50 hp

To carry the heavy load through the internal speed transmission, company engineers have incorporated dual belts in these motors, additions to company's Varidrive line. The dual belts are intended to distribute the load so no undue strain is imposed, and to counterbalance the belt load, tension control known as Autotaut has been designed. This principle is said to avoid extra flexing of belts over idlers and other disadvantages.

A calibrated spring is used to maintain pressure between two halves of

piping upkeep *costs more* now!

You spend less for it by using Dependable Quality

CRANE VALVES

. . . That's why more Crane Valves are used than any other make

Pressure-Seal Bonnet Gate—available in 600, 900, and 1500 pound classes

NO BONNET JOINT LEAKAGE . . .
NO BONNET JOINT MAINTENANCE

Big maintenance savings can be made on high-pressure/high-temperature piping services by using Crane Pressure-Seal Bonnet valves in place of bolted bonnet valves. Once installed, these valves rarely need maintenance of the bonnet joint—line pressure keeps it leak-tight.

Lighter weight and more compact dimensions make savings in piping erection and suspension. Streamlined body design reduces insulating costs.

Other outstanding and typical features of Crane Pressure-Seal Bonnet Joint design are tailored-to-the-service alloy steels, Stellite trim, deep stuffing box, and flexible wedge disc in larger gates. In gates, globes, angles, or stop-checks, these valves are an investment in better piping performance at lower ultimate cost.

CRANE

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Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

the driven varidiscs and the sides of the belt. The spring takes up any slack that may develop from stretch or wear of the belts, manufacturer points out, and the use of dual belts doesn't affect ease of changing motor speeds which is done by tuning a control dial. U. S. Electrical Motors, Inc.

9—REPLACEMENT CONTROLS

With pry-off dust cover to simplify fitting right switch to right control

Instead of the former separate dust-cover lid held in place by lugs engaging with side straps on the control proper, the redesigned Ad-A-Switch control features a single-piece metal casing with scored center section and tab. This readily prys open and tears off, leaving control casing open to take proper Ad-A-Switch. Two lugs on the Ad-A-Switch engage with side straps and are slightly bent to hold switch in place. Clarostat Mfg. Co., Inc.

10—NEOPRENE AIRDRY COATING

For maintenance work on structural steel, concrete, wood, tank exteriors

Gaco Neoprene Maintenance Coating is applied by brush or spray gun in a single coat of 5 to 10 mils thickness. Its outstanding properties are high resistance to oil, grease and chemicals, resistance of age-cracking by sunlight, weather and ozone, also resilience, elasticity, high abrasion resistance, non-chipping.

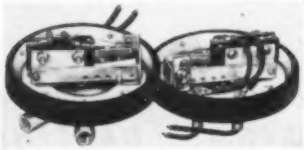
Another outstanding feature stressed for this coating is the fact that it develops its desirable physical properties without benefit of heat. It is a solvent solution of a neoprene composition, according to company; it doesn't gel in the container, but cures at normal temperatures after solvent has evaporated. Its field of usefulness is expected to be in applications where intermittent contact with liquids or constant exposure to corrosive fumes create protective coating problems too severe for many types of bituminous or oil-base industrial paints. Under conditions where these paints have a normal life of 2 or 3 yr, this coating is expected to last 5 to 10 yr. Coverage is about 550 sq ft per gal per mil; base price is $7.10 per gal. Gates Engineering Co.

11—LOW PRESSURE SWITCH

Is high sensitivity unit, designed to respond to slightest pressure change

This pressure-actuated switch is described as extremely accurate for indicating pressure drops in air filters, across coils, to indicate power or blower failure, actuating motors on automatic air equipment, to warn against unsafe or uneconomical operating conditions in forced air feed and boiler draft, and used with pilot static head to indicate air velocities above or below standard or safe values.

The slack diaphragm is linked to a beryllium copper spring with a Micro-Switch actuated by pressure from the spring. Pressure changes are reflected in the spring movement and in turn the Micro-Switch opens or closes the circuit. The Micro-Switch, rated at 10 amp, 110 v a-c, is capable of operation on plus, minus or differential pressures up to 4 in. of water for standard models.



Available in two models, No. 1620 has a 4½ in. dia., Model No. 1625, a 7 in. dia. Switches come in connection styles suitable for front, flush, or semi-flush panel mounting and ⅛ in. pipe connections are provided. F. W. Dwyer Mfg. Co.

12—HYDRO-PNEUMATIC PUMP

Is redesigned unit, now more compact and lighter in weight

Suggested for use in testing tubing, valves and pressure vessels and in other services requiring high pressure at small volume, the Aldrich-Lytel Hydro-Pneumatic Unit is self-contained and uses normal plant air as the power medium. It is designed to provide up to 20,000 psi at small volume. The Aldrich Pump Co.

13—DOUBLE-CLOSURE BIN VALVE

Consists of two rubber sleeves joined by a rotating steel collar

Dust- and drip-tight closure credited to the Twistite is obtained by pulling on a cable wrapped around the rotating collar, sealing the opening with a twist in each of the ruller sleeves. Valve is self-opening, the elasticity of the rubber sleeves causing them to resume their cylindrical shape when tension on cable is released. Company points out that since the rubber sleeves can wrap themselves around lumps caught in the valve during closure there is no danger of leakage due to variation in size of material particles.

The Twistite can be hand controlled locally by mounting a ratchet lock on the valve to hold the cable in the closed position. Remote hand control is obtained by mounting ratchet lock at desired location and running control cable to it by a pully arrangement. Valve can also be controlled by a small actuating motor.

The standard 6-in. size weighs 35 lb with ratchet cable-lock mounted on valve frame. It handles lump sizes to 2½ in.; requires a 30-lb cable pull for closure. Stephens-Adamson Mfg. Co.

14—TIME DELAY SWITCH

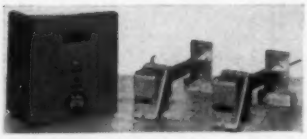
For electric solenoid valve controls used with air or hydraulic cylinders

This simple low-cost time relay control switch is designed to permit time dwell from ¼ to 10 sec, and is adjustable to provide any delay within its range. An important feature claimed for it is that its small size permits mounting near the mechanical stop without interfering with machine movement. The switch automatically resets itself after each actuation. Time delay adjustments are made by turning a knurled screw which moves the switch position in relation to the piston lever arm. Pneu-Trol Devices, Inc.

15—COMBUSTION SAFEGUARD

For immediate cut-off of fuel in case of failure of gas pilot

Co-ordinated equipment in this electronic safeguard system includes a switch-amplifier-contactor unit, phototube holder, and electrode holder. According to manufacturer, the system provides positive protection against combustion failure because; if gas pilot



doesn't ignite, the oil valve can't open; and if the oil flame doesn't ignite, the fuel supply is cut off. After cut-off, the motor continues to operate for 30 sec to purge the nozzle or cup of unburned fuel to prevent carbonizing. The system is then locked against further operation until manually reset.

An oil temperature thermostat can be used with the circuit to assure satisfactory fuel oil temperature before the starting cycle begins. The motor circuit is controlled directly by the built-in contactor for motor ratings as high as ½ hp, 110/120 v, single phase. For larger motors and multi-phase operation magnetic switches are used in conjunction with the master control unit. Control Divs., General Electric Co.

16—FILTER CLEANER

Saves time, labor in cleaning filters in air conditioning systems

Permanent type filter elements used in air conditioning systems may be cleaned much faster and with less work than by methods generally in use, according to manufacturer of the new Safe-N-Ezy Air Filter Washer-Oiler. This machine has been used by railroads for cleaning air filters used on diesel locomotives and passenger cars, which are the same type of filters used in many air conditioning and ventilation installations.

Even the dirtiest of filters are said to come out clean when processed in this machine because it works on the principle of centrifugal force. Filters spin in an interior basket of the washer throughout the complete cycle; they are cleaned, rinsed, spun dry and oiled all in one continuous operation. Requiring a floor area of only 6 ft 10 in. by 4 ft 4 in., the machine can be installed in an out-of-the-way location. Paxton-Mitchell Co.

17—CLUSTER LIGHTS

For outdoor protective lighting, are designed to conserve aluminum

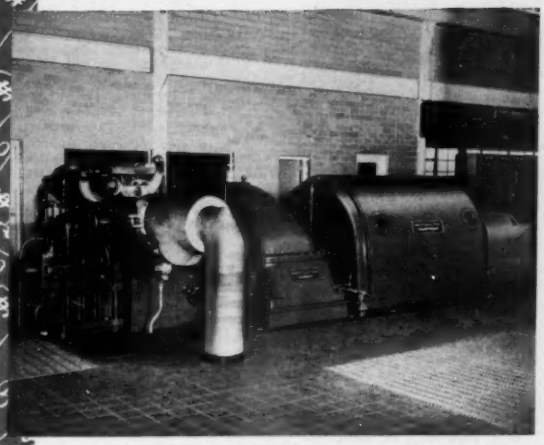
The new weatherproof Stonco Cluster Box 25 combines tough aluminum alloys that are precision die-cast under pressure to provide greater structural strength with less aluminum by weight than in many wiring troughs available for this purpose. A removable cast aluminum cover plate sealed with cork gasket is provided for easy access to inside wiring and addition of supplementary lampholders.

Each box has six holes tapped ½ in. IPS to take up to five standard lampholders for 150-, 200- and 300-w out-

FACTS ABOUT THE

Most Profitable Turbine Generator Investment

YOU CAN MAKE...



One of two Worthington 4000 kw turbine generator sets installed in a mid-western municipal power plant, operating on 600 #G and 750 F.T.T. Steam exhausting to 28" Hg vacuum.

Worthington's Experience and Undivided Responsibility Assure Low Cost, Dependable Power

Builders of steam turbines for over 30 years, Worthington's Steam Turbine Division is backed by the experience and resources of the entire Worthington organization — recognized leaders in the power plant field for more than a century. In view of today's increased turbine pressures and temperatures — and the resulting needs for new and special materials — this vast, combined source of technical knowledge has proved of tremendous practical value in developing turbine design, construction and performance.

Generators Are Worthington's, Too

The generators used with Worthington Turbines are built by a Worthington subsidiary that has specialized in this field for over 45 years. This means that Worthington, as manufacturers of *complete* turbine generator units, assumes *undivided responsibility* for the coordinated design, assembly and performance of these units.

Before shipment, Worthington Turbines and Generators are assembled together *as units* for testing and adjustment — eliminating the necessity for doing this after installation. Also, for installation and service, Worthington turbine specialists and regular Worthington service men are always available from our District Offices throughout the country.

Check These Over!

Adding up, Worthington's matchless power plant experience . . . huge manufacturing facilities . . . long specialization in both turbine and generator manufacture . . . undivided unit responsibility . . . and skilled technical service . . . are the best assurance you can get anywhere of efficient, economical steam turbine power.

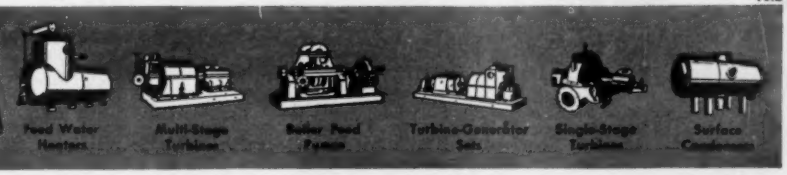
Worthington makes turbines in a wide range of sizes and types, each one designed to make steam do more work. For details proving *there's more worth in Worthington*, contact your nearest Worthington representative. Or write to *Worthington Pump and Machinery Corp., Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

STEAM TURBINES

T0.2

A GREAT TEAM IN STEAM



door weatherproof reflector bulbs. Accessories available include slip fitters for pipe mounting and brackets for wall mounting; mounting directly to ½ in. conduit is made without accessories. Stone Mfg. Co.

18—INTERNAL PURIFIERS

For evaporators, large tanks; to remove entrainment from vapors

These "upflow" purifiers are credited with extremely high efficiency, and pressure drop is reported negligible even at vapor velocities in excess of 25,000 fpm. Three models are available: the Type AFE is a one-piece unit for installation in evaporators with a large outlet nozzle through which it can be passed for assembly; Type ADF-1 is made in five parts for installation through a large manway or similar rectangular space provided for access. An 11-piece assembly, AFD-2 is designed to permit installation in chambers where access may be made through small outlet nozzles or cramped manways.

Assembly within tank or evaporator may be done with a continuous weld, flange assembly, or stud bolt support. All-welded mild steel is standard, but with required priorities purifiers are available in other materials. In addition to purifiers' use for removal of entrainment from moving vapor, steam, gas and air, the units can be used for reclamation of product otherwise lost in carry-over. The Centrifix Corp.

19—HIGH POWER RELAY

Mercury plunger type, with load ratings up to 35 amp and 440 v

Similar to company's standard line of 1-, 2- and 3-pole relays, the new Model EM-8 is said to have a test life of 100 million operations and to require no maintenance because of its hermetically sealed mercury-to-mercury design.

The relay uses an energizing coil in a resonant circuit so that the external contact (mercury thermometer, instrument contact, etc.) need carry only sufficient power to detune the circuit. This external contact power is given as equivalent of 100 v, 8 ma a-c. Power amplification is 10,000; load ratings are 35 amp 115 v, 30 amp 220 v, 20 amp 440 v, with almost unlimited inrush current. Ebert Electronics Corp.

20—INDUCTION REGULATOR

Has new arrangement of windings, made for 120-600 v and 12-85 kva

Complete new line of three-phase, dry-type, induction voltage regulators to meet the ever-increasing industrial demand for regulated three-phase power at low voltages, is shown here.

The new line includes both self-cooled and forced-air-cooled regulators in standard 10 per cent and 20 per cent (raise and lower) ranges of regulation.

The new standard line is being offered in ratings from 120 to 600 v and from 12 to 85-kva. Three-phase, dry-type ratings have been available in these sizes in the "Triplex" assembly, which consists essentially of three single-phase regulators on a single base. However, the new arrangement of the three-phase winding on a single core makes possible a considerable saving for users of three-phase voltage regulators, in the ratings being offered.

Housed in an all-steel, ventilated cabinet, the unit is protected from excessive dust collections by the cabinet design.

The manufacturer emphasizes that the new design is not intended to entirely replace the "Triplex" assemblies. Certain applications and some ratings (especially the smaller sizes) lend themselves more readily to the "Triplex" than to the new "conventional" design. Transformer and Allied Product Divs., General Electric Co.

21—CALIBRATED DIAL

For use with temperature regulators to provide quick, dependable settings

Designed for use with company's Class T and M Temperature Regulators, requires only a quick turn to desired setting; it isn't necessary to wait for equipment to heat up to find out if setting is correct. It is also intended to protect against overheating caused by guess setting and is designed for use under rugged operating conditions, such as where frequent readjustments are necessary. Dial fits in place of standard adjusting sleeve and can be installed on company's regulators already in service. Leslie Co.

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

INSTRUMENTS AND CONTROLS

201 For Centralized Control—Bulletin 109, 4 pp, presents the new, compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes and illustrates vertical-scale indicator units, selector valve and remote manual relay. Bailey Meter Co.

202 Remote Reading Flow Meters—Data Book 702, 32 pp, fully illustrates and explains flow measurement problems and offers suggestions for their solution. Meter bodies, differential devices and reading instruments are fully described. Republic Flow Meters Co.

203 Flow Meters—Bulletin 400-F2, 8 pp, features company's meter for measurement of steam, air, or gas flow in 1 or 1½ in. pipe lines, and designed for installation directly in the line being metered. Illustrated with photos of meter, sectional and dimensional drawings, bulletin discusses meter's advantages. Builders-Providence, Inc.

204 Putting the Ratio Totalizer to Work—Twelve suggested applications of company's ratio totalizer in automatic control circuits are described and illustrated by diagram in 8-pp Bulletin 5450. This new device is a pneumatically operated control mechanism for combining input control pressures and spring forces to produce a single output control pressure. Hagan Corp.

205 For Practical Men—That's the title of this 24-pp pocket-size booklet presenting insulation testing in simple language. Packed with maintenance hints, it explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in terms of long run economy and prevention of shutdowns. James G. Biddle Co.

206 Air Locks—Bulletin S-31, 2 pp, describing company's air locks and trip master controls for holding regulating and control valves in position during failure of air supply, is illustrated with photos, diagrams and line drawings. The Swartwout Co.

207 Flow Tubes—Catalog 80, 4 pp, presents engineering data on a new primary element for measuring, regulating and controlling fluid flow. Tells how these flow tubes are designed and how they function and discusses their advantages. Foster Engineering Co.

208 Control equipment—General Catalog 001, 30 pp, is devoted to measuring and control equipment for water and sewage works, power and processing industries. Catalog illustrates and describes in detail: venturi tubes and meters, controllers, gages, manometers, pilot equipment. Simplex Valve and Meter Co.

209 Pressure Regulator—Bulletin 1-B, 8 pp, discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for controlling back pressure relief valve and high pressure make-up valve. Atlas Valve Co.

210 Wired Television—Illustrated Bulletin 1025, 16 pp, introduces company's Utiliscope, a camera and monitor type of equipment designed to enable an observer to see where he can't look. Some of the applications described and illustrated include viewing instrument readings at remote points, checking boiler water levels, watching coal flow in chutes, watching hazardous tests, checking furnace ignition. Diamond Power Specialty Corp.

211 Steam Calorimeter—Company's U-path steam calorimeter which combines a throttling separating and re-evaporating calorimeter in a single chamber and offers extreme accuracy is described in Bulletin 118. Ellison Draft Gage Co., Inc.

BOILERS AND AUXILIARIES

212 Shop-Assembled Boiler — Eight-pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock and Wilcox Co.

213 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm in such a way as to provide dependable operation at maximum temperatures, discusses its advantages. The Wickes Boiler Co.

214 Tube Expanders—Bulletin 380, 8 pp, covers manufacturer's line of tube expanders for maintenance of high pressure boiler tubes, superheaters, economizers, circulating tubes, steam generators other equipment. Thomas C. Wilson, Inc.

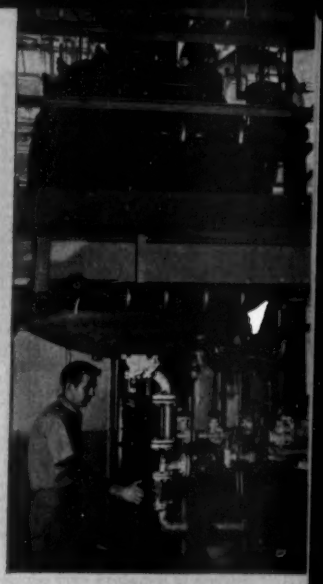
215 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Also includes data on motors, hose. Roto Div., Elliott Co.

216 Water Tube Boilers—Eight-pp Bulletin SB24B describes and illustrates water cooled boilers with integral water cooled furnace. Explains design features that contribute to positive circulation and low maintenance, as well as construction advantages. Includes dimensions, photos of five installations. Erie City Iron Works.

Chas. Pfizer & Co., Inc., is the discoverer and sole manufacturer of terramycin, the newest "wonder drug," which has proved effective in the treatment of *more than 50 acute infections*. Pfizer is the world's largest producer of antibiotics and a leading producer of synthetic Vitamin A.

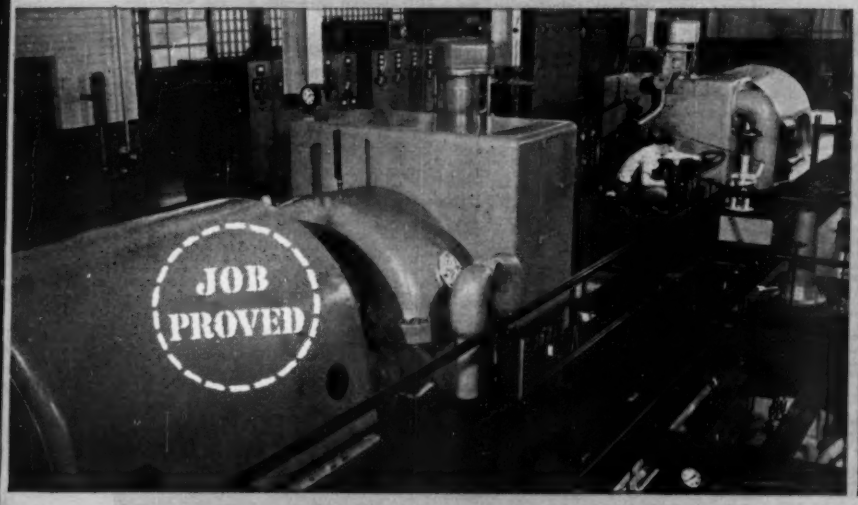
Power—lots of it and never failing—is needed by Pfizer's modern plant at Groton, Conn., to safeguard round-the-clock production. The plant relies entirely upon its two steam turbines for power, light, and refrigeration. For the utmost protection, "Job Proved" Sunvis 916 Oil was chosen as the lubricant for these turbines when installed—two years ago. This Sunvis 916 has been in continuous service ever since. As expected, inspections show the turbines free from rust, sludge, and corrosion; and laboratory tests show the oil ready for thousands of hours of continued service.

Sunvis 900 Series Oils are unsurpassed as turbine lubricants. Under normal operating conditions they will be *good for the life of your turbines*. For complete information, telephone the Sun Office nearest you or write Department PN-4.



THE EQUIPMENT pictured here is utilized in one of the stages of a complex process that Chas. Pfizer & Co., Inc., world's largest producer of antibiotics, follows in the manufacture of its new "wonder drug," terramycin.

POWER FOR "WONDER DRUG" PRODUCTION PROTECTED BY SUNVIS TURBINE OIL



TWO 2,500 KW TURBINES, each charged with 300 gallons of Sunvis 916 Oil, generate all of the plant's power. The condensing-extraction unit has been running over 15,000 hours, the back-pressure unit over 7,000 hours.

THE LUBRICATING OIL flows continuously through a layer of wool, then a tank of water, and finally a triple bag filter. Recent tests at Sun's laboratories show that the oil is in excellent condition, and good for thousands of hours more.

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO

217 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's preheater, discusses its application to boiler plants. Several installations are illustrated. The Air Preheater Corp.

218 Soot Blower Head—Illustrated Bulletin 485, 4 pp, describes a new rotary soot blower head for improved boiler cleaning. Explains how blower head is designed to give maximum blowing pressure through the full blowing arc, is rugged, easily serviced, economical. Vulcan Soot Blower Div., Continental Foundry & Machine Co.

WATER TREATING, CORROSION PREVENTION

219 Water Conditioning Information— Here are three informational bulletins of value to power engineers. No. 28X7446 describes a simple and accurate way to determine total hardness in water, illustrating procedure and explaining principle. No. 28X7559 gives an analysis of the hot process-hot zeolite system, telling results to be expected and advantages. No. 28X7466 discusses current status of embrittlement in boilers, explaining causes and telling recent developments in control methods. All three bulletins available, list those wanted. Allis-Chalmers Mfg. Co.

220 Modern pH and Chlorine Control— This 100-pp booklet gives technical details of company's color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on the meaning of pH control, electrometric and colorimetric methods of determining pH and also determining impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

221 Water Softeners — Bulletins WC-102 is a 36-pp presentation of recent developments in hot-process water softeners. Explains boiler plant troubles caused by various impurities in water, outlines 12 methods of treating water to eliminate these impurities, describes reasons for the popularity of the hot-process method and its advantages, and explains the chemistry of hot-process water softening. Graver Water Conditioning Co.

222 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50, 4 pp. Procedures, reagents, and equipment are pictured and described. Bulletin tells how tests may be used to determine water hardness, hardness due to calcium alone and hardness due to magnesium alone. Hall Laboratories, Inc.

223 Boiler Water Treatment — Bulletin 47, 8 pp, is on internal treatment of boiler water. Defines internal treatment and tells its advantages in softening, sludge conditioning, stabilization. Explains operation of company's system, including the chemicals used. National Aluminate Corp.

224 Ion Exchange Systems — "Amberlite Monobed Deionization" is a 12-pp miniature textbook covering the history, behavior, present performance, and potential uses of the Monobed ion exchange systems in water-conditioning, chemical processing and other industries. Reactions of various combinations of exchangers are explained in text and equations. Also discussed are operating costs, equipment costs, quality of product derived, rinse requirements and other properties as they apply to the complete or partial single-step removal of ionized solids. The Resinous Products Div., Rohm & Haas Co.

225 Pocket Book on Chemicals — Here's a handy little 28-pp manual covering chemical products used by the power engineer. Most of those listed are water treating chemicals, but there's also a brine treatment, a fuel oil sludge dispersant, a soot remover, and protective coating. Tells what each product does and how and where to use it. Includes a helpful reference chart suggesting the application of these products. Western Chemical Co.

226 Boiler Water Manual—Factual information on standard methods of applying chemicals in the treatment of water for boilers is presented in this 16-pp technical bulletin, called Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and to feedwater system, condensate returns, flushing. %Proportioneers, Inc.%

227 Water Softening Equipment — How the problems caused by hard water can be offset by the use of water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. Illustrates a fully automatic softener. The Permutit Co.

228 Water Treatment — Bulletin 5060, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations to suit individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment and test control. Filled with illustrations, this helpful booklet also describes available equipment and includes a reference bibliography of literature on specific formulations. Dearborn Chemical Co.

229 Boiler Corrosion—A 12-pp article discussing the cause and prevention of corrosion in boiler systems is presented in Betz Technical Paper No. 111 titled "Corrosion: Its Effect in Boiler Systems." The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity and physical factors are evaluated. W. H. & L. D. Betz.

230 Two-Stage Water Conditioner—Bulletin 4801 describes a water conditioner which combines advantages of both hot process and zeolite softening. Explains operation of softener in which first stage is the hot process using lime or Dolomitic lime and second stage the zeolite reduction of hardness. Cochrane Corp.

231 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a 4-pp folder covering amine treatment for inhibiting of boiler and condensate systems. This treatment is described as affording surface protection of the metal itself as well as raising the pH value of the condensate. Gives case histories and economies obtained by power plants using this treatment. The Bird-Archer Co.

ELECTRICAL

232 The Why of Dry Type Transformers —Booklet B-4428, 24 pp, discusses reasons why dry-type transformers are safer and less expensive to install and maintain in industrial plants and utilities. Types of air-cooled transformers for every use are illustrated from small ones for operation of intercommunication systems to power centers as large as 10,000 kva. Also describes sealed, submersible, dry-type transformers for installation underground. Westinghouse Electric Corp.

233 Power Factor Correction—Examples showing basic considerations in the improvement of system power factor are contained in Bulletin 05B7465, 4 pp. Points out economical and operational advantages of improving plant power factor and advisability of keeping the load power factor up to 0.8 lagging or higher; tells how the effects of low power factor can be corrected. Allis-Chalmers Mfg. Co.

234 Synchronous Motors — High speed synchronous motors are described in 4-pp bulletin PB 5600-1. The bulletin is packed with descriptive matter and photographs explaining features. Elliott Co.

235 Low-Speed Synchronous Motors — Publication GEA-5332, 8 pp, illustrates typical installations of efficient high-power factor, constant-speed drives, describes their construction features, and indicates mechanical modifications and performance data. General Electric Co.

236 Care of A-C Rotating Equipment— To promote intelligent and consistent maintenance of electrical machines, company has published Bulletin 05R7417, which is a series of articles by Fraser Jeffrey. Contents of the 24-pp booklet cover preventive maintenance and machine repairs, and such subjects as drying moist insulation, measuring insulation resistance. Allis-Chalmers Mfg. Co.

VALVES, TRAPS, PIPING

237 Bonnet Valves—"Pressure-Seal" bonnet valves are described and illustrated in Form AD-1319. Includes sizes, dimensions, ratings and tests for gate, globe, angle and stop check valves for high pressure and high temperature service. Also explains operating advantages, tells how pressure seal is made. Crane Co.

238 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blower, water column blow-down, and other types of pipe line. Includes tables of dimensions, weights; list prices. Everlasting Valve Co.

239 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special construction features and other advantages. E. M. Dart Mfg. Co.

240 Blow-Off Valves—Illustrated Bulletin B-433, 24 pp, describes blow-off valves for high-pressure boilers, and covers seatless, hard-seat and unit-tandem types, for working steam pressures from 400 to 2500 lb. Construction details and operating principles are illustrated by cutaway drawings. Dimensions and specifications included. Yarnall-Waring Co.

241 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes—150 to 2500 lb—and include globe and angle, gage, instrument, hydraulic and relief types, also strainers, and check, gate, non-return and blow-off valves. Explains special design features, gives construction details, dimensions, ratings, material specifications. Edward Valves, Inc.

242 Valves, Fittings and Flanges—Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides not only ordering information on company's complete line, but also much helpful engineering and application data, and includes a section on products for refrigeration service. Fully illustrated, well-indexed. Available to qualified power engineers, please give your title. Henry Vogt Machine Co.

243 Automatic Valve Specialties — Company's pressure, flow, and liquid level controls for steam, air, gas, water, oil and other fluids are shown in 60-pp Condensed Catalog A-50. All equipment is described as to construction and application. Dimensions and prices are included. Technical data includes capacity charts and conversion tables. Davis Regulator Co.

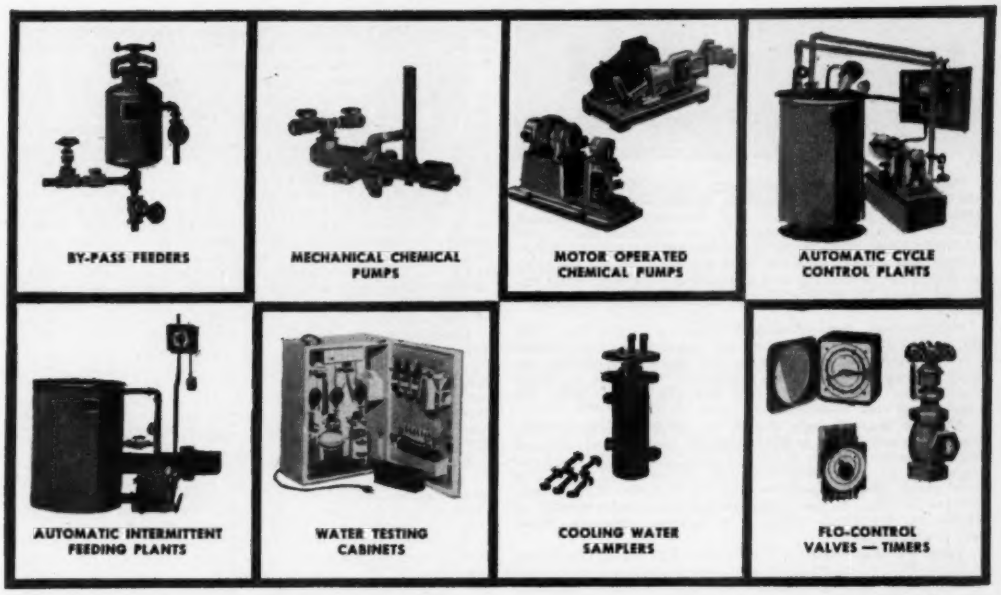
244 Pressure Reducing Valves—Selection and engineering data on pressure reducing valves, including those for remote control of reduced steam or water pressures, are presented in 12-pp Bulletin 477-A. Also described is company's desuperheater. Northern Equipment Co.

245 Steam Traps and Temperature Controls—Here is a comprehensive catalog comprising many of company's bulletins on steam traps and related equipment, including an illustrated steam trap selection chart. Provides data on boiler steam traps, air eliminators, thermostatic steam traps and air vents, inverted bucket steam traps, temperature regulators and cooling controls, steam and water mixers, thermostats and strainers. Contains sizes, application data, prices. Sarco Co., Inc.

246 Steam, Air, Gasoline Traps — This 32-pp illustrated catalog, No. 230, describes five types of thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air and gasoline service, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb, and also steam, air and gas separators. Includes capacity tables, installation diagrams. W. H. Nicholson & Co.

247 Handbook on Fittings and Flanges Catalog wf-1950, 88 pp, is packed with working information on seamless carbon steel welding fittings and forged steel flanges. In addition to presenting standard schedules with their specifications, list prices and sizes, book gives information on dimensional tolerances; American standard flange facings with dimensions; thread standards and threading practice; service pressure ratings, physical and chemical requirements for flanges, nuts and bolts; plus

(Continued on page 126)



PLUS results from water treatment with

Dearborn engineered equipment

In addition to supplying the correct treatment to meet your *specific* water conditions, Dearborn will engineer the entire treatment system to provide maximum efficiency in your boiler room or power plant.

Dearborn will analyze your existing equipment and the physical layout of your plant. With this information, Dearborn will recommend how you can improve the efficiency of your plant, whether it be to include a pump or timer—a test cabinet—or an automatically controlled feeding system to replace inaccurate feeding.

Discuss your water treatment and equipment requirements with a Dearborn sales engineer. He will gladly show you how Dearborn's broad experience in this field, since 1887, will save you time and money.

DEARBORN CHEMICAL COMPANY
310 S. Michigan Ave. • Chicago 4, Ill.

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

WHAT EQUIPMENT DO YOU NEED FOR YOUR BOILER WATER TREATMENT?

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- ☐ Chemical Pumps, Mechanical
- ☐ Chemical Pumps, Acid
- ☐ Timers
- ☐ Motor Starters
- ☐ Continuous Blowdown Systems
- ☐ Cooling Water Samplers

TANKS
- ☐ Hand or ☐ Mechanical AGITATION (circle capacity desired) 53, 110, 180, 330, 580 or 1,350 gallon capacity.

FEEDING SYSTEMS
- ☐ By-Pass Feeders
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VALVES
- ☐ Flo-Control
- ☐ Acid-Resistant Check Valves
- ☐ Acid Regulating and Shut-Off

★ ★ ★

Dearborn Chemical Company, Dept. PG, 310 South Michigan Ave., Chicago 4, Illinois

Gentlemen:
Please send information on the equipment checked in the above list.

Name.....

Company.....

Position.....

Address.....

City.....*State*.....

POWER PLANT Construction News

Decatur, Ala.—Chemstrand Corp., care of Monsanto Chemical Co., 1700 South 2nd St., St. Louis, Mo., recently organized joint subsidiary of that company and American Viscose Corp., Marcus Hook, Pa., to manufacture a new synthetic fiber, plans power plant at mill at Decatur, where tract of 650 acres of land has been acquired. It will comprise several large processing and production buildings. Cost reported about $10,000,000. Completion is scheduled early in 1952.

Hot Springs, Ark.—Arkansas Power & Light Co., Pine Bluff, Ark., plans extensions in Lake Catherine steam-electric generating station, near Hot Springs, including installation of new 66,000-kw generator unit and auxiliary equipment. Proposed to carry out project in 1951. No estimate of cost announced.

Atlanta, Ga.—Georgia Power Co., Electric & Gas Bldg., has authorized a fund of $34,500,000 for new construction and improvements in 1951, the majority of fund to be used for expansion in generating facilities. Project will include a new steam-electric power plant on Crispen Island, near Brunswick, Ga., to be equipped for an initial capacity of 40,000-kw, previously referred to in these columns. Work will begin soon.

Valdosta, Ga.—Georgia Power Co., Electric & Gas Bldg., Atlanta, Ga., plans expansion in steam-electric power plant at Valdosta, with installation of equipment for increased capacity. Cost reported about $4,500,000.

Hennepin, Ill.—Illinois Power Co., Decatur, Ill., will proceed with work at once on proposed new steam-electric generating plant on Illinois River, near Hennepin, to be equipped for initial capacity of 60,000-kw, which will be doubled at later date. Project is estimated to cost about $16,500,000, including power substations, transmission lines and other operating facilities.

Lockport, Ill.—Public Service Co. of Northern Illinois, 72 West Adams St., Chicago, Ill., has acquired tract of about 215 acres of land near Lockport, and will use as site for new steam-electric generating station, for which plans will be prepared soon. Initial installation will include a 150,000-kw turbine-generator, high-pressure boiler and accessory equipment. No estimate of cost announced.

Baltimore, Md.—Consolidated Gas, Electric Light & Power Co., Lexington Bldg., plans extensions in Gould St. and Riverside steam-electric generating stations, with installation of new 100,000-kw and 75,000-kw turbine-generators and auxiliary equipment, respectively. Work will form part of 1951 expansion and improvement program in plants and system, estimated to cost about $29,000,000.

Boston, Mass.—Boston Edison Co., 39 Boylston St., plans an expansion and improvement program to be carried out over a 48-mo. period, 1951-1954 inclusive, to cost $65,300,000, of which close to $20,000,000 will be expended for new generating equipment, with remainder to be used for power substations, transmission and distributing lines, and miscellaneous operating facilities. Company has work in progress on an addition to Edgar steam-electric generating plant at Weymouth, Mass., to include installation of a new 81,250-kw turbine-generator and auxiliary equipment. Completion of this project is scheduled in 1952.

Jackson, Mich.—Consumers Power Co. is arranging a budget of about $48,000,000 for expansion and improvements in plants and system during 1951, including increased generating capacity, power substations, transmission lines and other facilities. Appropriation provides for completion of new Justin R. Whiting steam-electric generating plant on Lake Erie, on which construction is now in progress. Station will be equipped for a rating of 276,000-kw, divided into two units, the first of which is scheduled for operation in 1952.

Granite Falls, Minn.—Northern States Power Co., 15 S. 5th St., Minneapolis, Minn., plans expansion in steam-electric generating station at Granite Falls, with installation of new 40,000-kw turbine-generator, high-pressure boiler and auxiliary equipment. Estimates of cost are being made. Work scheduled to begin early in 1952. Pioneer Service & Engineering Co., 231 S. LaSalle St., Chicago, Ill., is consulting engineer.

Marshall, Minn.—City Council has authorized expansion in municipal steam-electric generating station, with installation of new turbine generator and auxiliary equipment. Cost reported about $500,000. Pfeifer & Schultz, Wesley Temple Bldg., Minneapolis, Minn., are consulting engineers.

Minneapolis, Minn.—Northern States Power Co., 15 S. 5th St., has plans nearing completion for proposed new steam-electric generating plant on local site on Lyndale Ave., S. and Minnesota River, to be known as Black Dog generating station. It will be equipped to use either coal or natural gas as fuel. Cost estimated about $10,000,000. Work on first unit will be placed under way soon.

Raleigh, N. C.—Carolina Power & Light Co., 336 Fayetteville St., is arranging an expansion and improvement program in 1951, to cost about $21,000,000, comprising power plants, transmission lines, power substations and other operating facilities. Work will include installation of new generating unit at power station at Lumberton, N. C., about 100,000 hp rating; and completion of new steam-electric power station at Goldsboro, N. C., with two initial units of 100,000 hp each.

Roanoke Rapids, N. C.—Virginia Electric & Power Co., Franklin and 7th Sts., Richmond, Va., has secured permission from Federal Power Commission to proceed with construction of proposed new hydroelectric plant on Roanoke River, near Roanoke Rapids, previously noted in these columns. Work is expected to begin at early date and will require over 24 months for completion. Project is estimated to cost $27,000,000.

Cleveland, Ohio—Cleveland Electric Illuminating Co., Public Sq., will proceed at once with foundations for proposed new steam-electric generating station at Eastlake, near Cleveland. It will cover an area about 1000 x 1200 ft. Installation will include two 125,000-kw turbine-generators, high-pressure boilers and auxiliary equipment. One unit is scheduled for completion in 1952 and the other a year later. Plant will represent an ultimate investment in excess of $75,000,000. Emery W. Rhoads, 1596 Mars St., Cleveland, is consulting engineer.

Sulphur, Okla.—Oklahoma Gas & Electric Co., 321 N. Harvey St., Oklahoma City, Okla., plans new steam-electric generating station near Sulphur, with initial capacity of about 66,000-kw. Cost reported close to $8,500,000. Proposed to begin work this spring.

Madras, Ore.—Portland General Electric Co., 621 S.W. Alder St., Portland, Ore., plans hydroelectric power development on Deschutes River, near Madras, where site has been selected. It will be equipped with hydraulic turbines and electric generators, with initial output of 106,000-kw. Entire project is estimated to cost approximately $20,000,000.

Portland, Ore.—Pacific Power & Light Co., Public Service Bldg., plans new hydroelectric generating station on Lewis River in Clark and Cowlitz Counties, Wash., with power dam about 305 ft high and generating station for initial capacity of 100,000 kw, and ultimate estimated output of 200,000 kw. Project will represent a reported investment of $33,000,000. Application for permission has been made to Federal Power Commission.

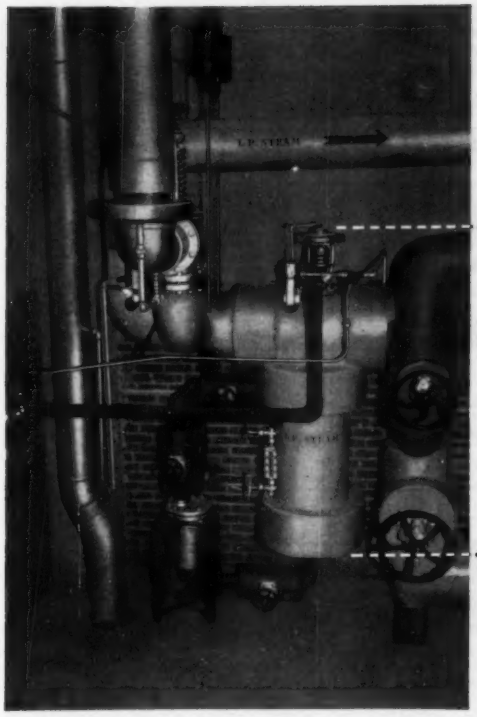
Portland, Ore.—United States Lime Products Corp., 1840 East 25th St., Vernon, Los Angeles, Calif., plans boiler house at new plant at Portland, where site has been secured. It will comprise several buildings, with cost estimated about $1,500,000. Work is scheduled to begin this spring.

Cromby, Pa.—Philadelphia Electric Co., 1000 Chestnut St., Philadelphia, Pa., has plans for new power plant at Cromby. Award is being made for steel frame superstructure and work is expected to begin early in spring. No official estimate of cost announced.

Scranton, Pa.—Willard Storage Battery Co., 246 E. 131st St., Cleveland, Ohio, electric storage batteries, plans boiler house at proposed new branch plant at Scranton, where site has been selected. Entire project reported to cost about $2,000,000. Work is scheduled to begin soon.

Gilmerton, Va.—Virginia Electric & Power Co., Franklin and 7th Sts., Richmond, Va., has authorized new steam-electric generating station on site near Gilmerton. It will be equipped for an initial capacity of 100,000-kw, with future extensions to develop an ultimate rating of 400,000-kw. Immediate cost estimated at $17,000,000. Proposed to begin work this spring. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is consulting engineer.

Oak Creek, Wis.—Wisconsin Electric Power Co., Public Service Bldg., Milwaukee, Wis., will build proposed new steam-electric generating station previously referred to in these columns near town of Oak Creek on Lake Michigan, Milwaukee County. It will be equipped for initial capacity of 120,000-kw, and is reported to cost in excess of $40,000,000. Work is scheduled to begin this spring. Contract has been let for structural steel framing.



8-inch COPES Desuperheater installed for flows of up to 95,000 pounds per hour, to reduce steam temperature from 750 degrees F. to 475 degrees F. 175 psi.

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Jenkins Brothers • Kaiser Co., Inc.
Mead Corp. • Monsanto Chemical Co.
National Lock Co. • Pennsylvania Railroad Co.
Pennsylvania Salt Mfg. Co. • Phelps Dodge Corp.
Procter & Gamble Manufacturing Co. • Pure Oil Co.
Rath Packing Co. • St. Regis Paper Co.
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DESUPERHEATER
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With the temperature control element built into the mixing chamber, you need no long run of alloy steel piping in the steam line—no extra connections into this line—no long run of piping back from the temperature element to the desuperheater. With cooling water atomized inside the chamber, you need no extra steam atomizing valve and line with extra stop valves.

Installed and ready for round-the-clock service, a COPES Desuperheater offers you more than appears in the purchase price.

First of all, you'll find the installation simple and inexpensive, no matter what your piping layout.

You'll find operation and maintenance easy and low cost because of compact design, rugged construction.

You'll find the temperature control accurate, even on lightest flows, because cooling water is controlled and atomized inside the mixing chamber.

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If you have a specific application in mind, write in detail about your requirements. If you want only general information, ask for Bulletin 405-C.

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350° F.

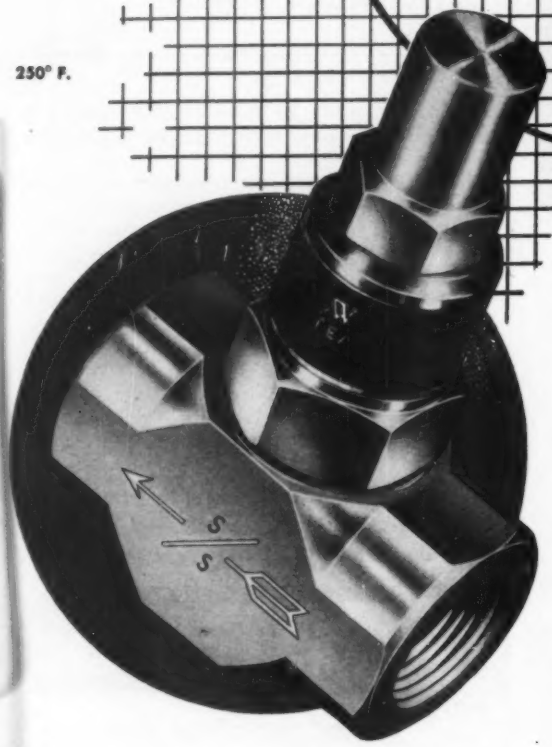
300° F.

250° F.

FOR EVEN TEMPERATURES

YARWAY

STEAM TRAPS



● Processes requiring careful temperature control call for Yarway Impulse Steam Traps on steam equipment.

The reason . . . Yarway traps maintain even temperatures because they *continually* sample and respond to a trickle of the condensate. There is no arrest in flow, no waiting for large quantities of condensate to accumulate, or trapped steam pockets to condense.

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- **Easy to install, easy to maintain**
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If you are not already familiar with these and other advantages of the Yarway Impulse Steam Trap, try one *for free* and find out for yourself. Call your nearby Yarway distributor, or write to:

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LETTERS TO THE EDITORS

A NOTE ON A BYGONE TUNE

AMONG MANY worth-while things of a bygone age which have been relegated to oblivion is the all-around building mechanic. Time was, when there were many good men around buildings and commercial establishments who could *fix* anything from a leaky faucet to the hydraulic or electric elevators but, today, there ain't no sech animal left, not many, at least. The day of the all-around building mechanic is about over. The specialist is here to stay. Elevator maintenance has gone over, almost completely, to outside contractors.

Why is this? First, although not the most important factor, is the growing complexity of the modern elevator installation. Years ago, when elevators were relatively simple, repair jobs and maintenance were done on week ends or at night. The thought of letting anybody work on the elevators during the day was positively abhorrent to management. The poor elevator mechanic was a gnome, a furtive sort of creature who only came out when everybody else had gone home. If he worked during the day, he was *used* to help the plumber, the electrician, or the boiler man. Management begrudged his existence as an individual. So, more and more of them quit and drifted into other jobs. If a mechanic wanted to work days, he had to quit the building maintenance game.

When labor was cheap it was treated contemptuously. We still think, I believe, as a people, that it is easier to talk our way into heaven than it is to work our way there. We reward our talkers a million to one more than we do our workers. Why? You tell me!

The elevator mechanic picture has changed a great deal. In the old days if management caught a guy joining a union, it cost him his job. Belonging to unions was considered disloyal to the company he worked for. However, loyalty to a company was cheapened to the point where it became almost degrading, silly at least.

A man has to have pride in his work to be happy; he likes to feel loyalty towards his co-workers and his boss, and if the elevator mechanic had been given a chance to develop pride in his work and loyalty to his associates, he would not now be virtually extinct in the building engineer's department. As a non-union night worker, it was rare if he got more than $250 a month, and everybody was his boss.

Elevator mechanics, today, occupy quite a different position in the industrial picture. Being employed by an outside contractor, management extends to him the same deferance and courtesy accorded the general public. We are, by virtue of our culture, more anxious to please outsiders than those we work with; indeed, we are less courteous to members of our own family than to our neighbors. Don't ask me why!

The once despised mechanic is permitted freedom of action. Now, the requirement that all elevator work be done at night or week ends, does not measure up with reality when the cost per man hour is double for night and week-end work. Ways have been found to permit use of off-peak idle time, or hours are set aside during the day for work on cars and machinery. Nobody, it appears, has been too horrified by mechanics working days instead of nights.

The point of this letter is to contrast the *good old days*, as far as the elevator mechanics are concerned, with their present status. Now, for a fixed fee of from $150 a month per car up, building management gets complete service. This rate amounts to a tidy sum during the course of a year, but strangely enough, everybody is happy. Building management, in my opinion, created this situation. It could have acted differently; it could have kept its own crew and I still think it would have been better in many respects to run its own show.

I have the utmost contempt for the building maintenance department heads who refused to deal with their own workers in a forthright manner, who abhorred unions, and to keep their *principles* dumped their own help on the streets, farmed out their maintenance jobs to management companies in which loyalty is a forgotten attribute—sentimental nonsense, they call it. At least, management sub-contractors deal with the unions; let the government pay the pensions.

I feel sorry for the *rugged individualist* today. The old-time elevator mechanic was one of them who played a losing game and was forced into a union or into business for himself.

A company would be horrified to have to pay its own mechanics one half or even one fourth as much as it cheerfully pays an outside company to do less work (in man hours) than their own mechanic would do. But if it is tied in with a few pounds of grease, a few spare parts, and *freedom from worry*, it's a fine deal.

I am not complaining—Oh no! I am just calling attention to the way things are—better hours, more respect, more money for less work. If that is what management wants, that is what it gets.

I wonder if you ever get any practical suggestions from elevator mechanics that might be of help to others. They, it seems, are not talking. *I* talk too much.

Hollywood, California W.S.

MORE ON BASIC POWER PLANT FIGURING

Enjoy Mr. Engelman's articles. Please let me know of book plans when "jelled." D. W.
Power Engineer

* * *

A complete reprint or bound book form of Mr. Engelman's articles is wanted very much.
G. W. M.
Design Engineer

* * *

Engelman's articles excellent.
S. G. G.
Staff Engineer

* * *

Have Wm. H. Engelman continue his good work. Include something on waste heat recovery from process work. J. A. S.
Manager

* * *

If tear sheets and copies are available for each of Mr. Engelman's articles, I would like to purchase. When the articles are in book form, I would like to purchase one.
J. S. P.
Chief Engineer
F. F. P.
Engineer

* * *

I would like to have Mr. Engelman's stuff in book form. Would like to have him show how to line up data on which to design a new generating plant.
Q. G. E.
Plant Engineer

* * *

Basic Power Plant Figuring—keeping all articles but would prefer a loose leaf book so it could be added to. S. L. B.
Fuel Engineer

* * *

Articles by Engelman best I ever read. Would like to see them in book form. F. M. S.
Power Engineer

* * *

Really missed Basic Power Plant Figuring in last issue. Very good articles. Would like to purchase in book form. J. G. L.
Operating Engineer

Power Engineering's FEATURE OF THE MONTH

By D. G. ILIFF
Mechanical Engineer
Ebasco Services, Incorporated

Semi-Outdoor Plant for —40 F Weather: The Frank Bird Steam-Electric Station

First major steam development by The Montana Power Co. nears completion at Billings, Mont. . . . It is a 66,000-kw turbine generator unit served with steam by a single oil-and-gas-fired, 675,000-lb-per-hr, 920-psig, 905-F steam generating unit . . . Outstanding feature is use of semi-outdoor construction, designed to withstand ambient temperatures as low as —40 F . . . Boiler, fans and turbine all outdoors . . . Only part of plant below operating floor is enclosed . . . Special provisions for centralized control rooms and for protecting piping . . . Details of design, supply of circulating water, heat balance and electrical diagrams and complete list of equipment for this plant . . . It is probably farthest north outdoor central station

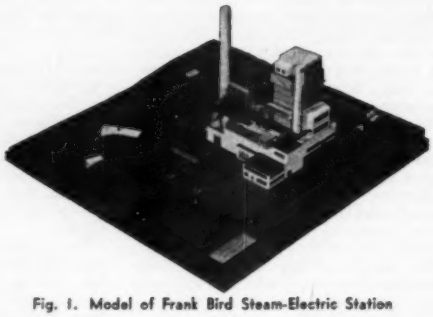


Fig. 1. Model of Frank Bird Steam-Electric Station

CONSTRUCTION of the 66,000-kw Frank Bird Steam-Electric Station, scheduled for initial operation in July, 1951, is part of the system expansion program of The Montana Power Co. now under way. The plant is named in honor of Frank W. Bird, president of The Montana Power Co., in recognition of his more than 40 years of service with the company. It is located near Billings, Montana, on the bank of the Yellowstone River.

The station constitutes the first major steam development made by the Montana company. The power system, which covers a large portion of the state of Montana, is supplied primarily from hydroelectric sources. Montana is a participant in the Northwest Power Pool, and maintains major interconnections with Utah Power & Light Co. and Idaho Power Co., and with U. S. Bureau of Reclamation operations at Fort Peck.

Frank Bird Steam-Electric Station will firm up the hydroelectric system during low-stream-flow periods, and will supply energy as required to supplement the hydraulic plants.

The long-time load factor may be as low as 30 per cent, but when in operation the unit will normally be called upon to develop its full capability.

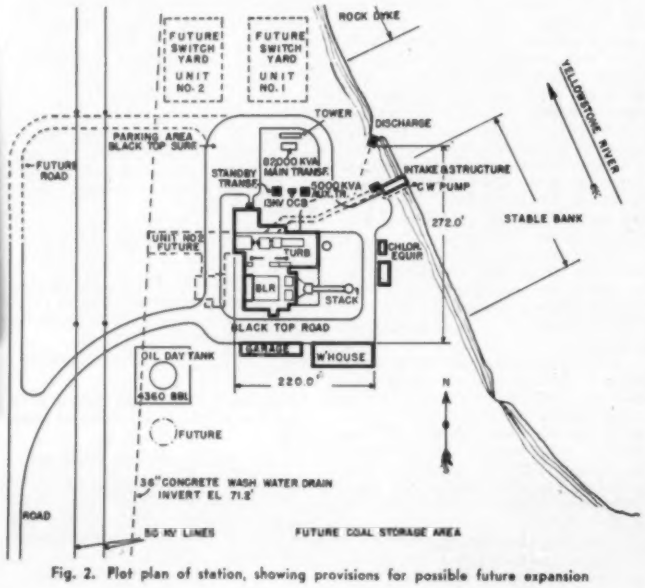


Fig. 2. Plot plan of station, showing provisions for possible future expansion

Semi-Outdoor Design a Feature

Semi-outdoor-type construction is adopted for this plant, giving low investment cost and low cost for operation and maintenance.

Ambient temperatures as low as —40 F are encountered in this region, and special care is taken in the design of this outdoor plant to meet this condition. Enclosures for housing the burner fronts, firing platform and steam-drum ends are provided for the boiler, and protection is arranged for headers, valves and connections at rear of unit. The area below the operating level is enclosed, so that heat radiating from the lower part of the boiler may be distributed by fans up to the control area. All control, drain, and instrument connections are protected from freezing by enclosing them in a pipeway within the boiler casing, or by other

means. Since the plant will be down entirely during maintenance periods and when its output is not required, a heating boiler is provided for use during cold-weather periods.

The plant is on the left bank of the Yellowstone River. Minimum flow of stream is approximately 430 cfs—adequate to provide condensing-water requirements for several units of this size. Water temperature seldom exceeds 65 F, which permits the use of a relatively small condenser.

Foundation conditions are very favorable, no piling being required. The station is built on a slab at about ground level, with no basement below grade.

General Design

Turbine generator is a 60/66-mw Preferred Standard unit. Steam conditions are 850 psig, 900 F, which are considered economic for expected fuel cost and load factor. The single outdoor-type steam generator is designed to produce sufficient steam for maximum requirements under all conditions. "Walk-in" housings, furnished by manufacturer, are provided at the high-pressure end of the turbine and around the exciter, but the unit as a whole stands on an open deck.

Control room is located at operating-floor level in the auxiliary bay, near the turbine end of the unit. The gantry crane, which serves turbine generator and auxiliary equipment, has a 35-ton main hook and a 10-ton auxiliary hook, with a span of 35 ft. Rails are embedded in the operating floor for the full length of the turbine bay. A two-story wing north of the turbine bay houses offices, locker space, laboratory, and first-aid room. Boiler platform levels, together with plant operating levels, are reached by an elevator.

Circulating-water-system intake structure, located on the bank of the Yellowstone River, is provided

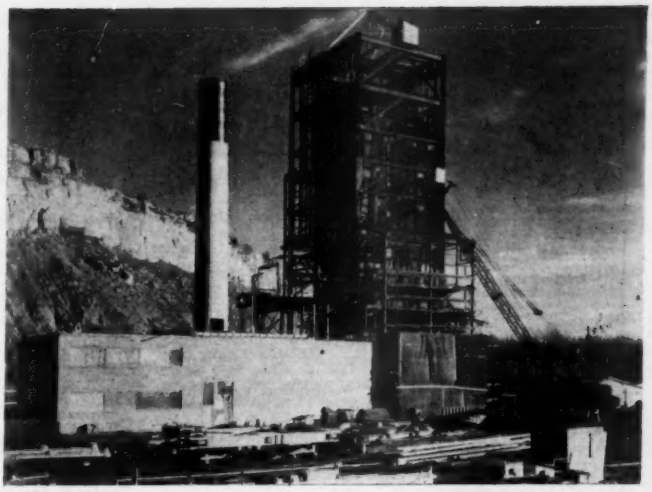


Fig. 3. View of Frank Bird Steam-Electric Station under construction as of February, 1951

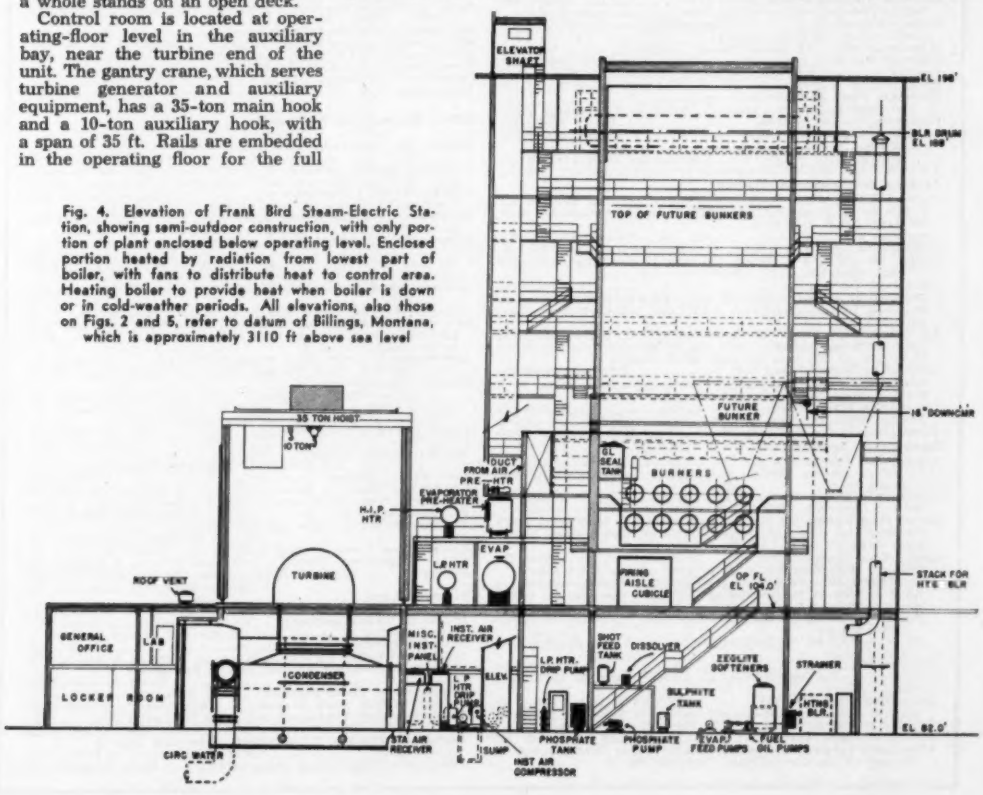


Fig. 4. Elevation of Frank Bird Steam-Electric Station, showing semi-outdoor construction, with only portion of plant enclosed below operating level. Enclosed portion heated by radiation from lowest part of boiler, with fans to distribute heat to control area. Heating boiler to provide heat when boiler is down or in cold-weather periods. All elevations, also those on Figs. 2 and 5, refer to datum of Billings, Montana, which is approximately 3110 ft above sea level

with coarse and fine screens. A single vertical circulating-water pump with a capacity of about 75 cfs discharges through a steel pipe to the condenser. A recirculating line is provided, so that approximately 30 cfs may be discharged upstream of the intake structure, to prevent formation of ice.

Four extraction lines are taken from turbine for feedwater heating; the fifth point is not connected. A deaerating-type condenser is used, eliminating the deaerating feedwater heater. Condensate pumps discharge through heaters directly into the suction of the boiler feed pumps. A 250,000-lb condensate surge tank is provided, with two motor-driven pumps, to supply water automatically through a heat-

PRINCIPAL POWER-PLANT EQUIPMENT

Frank Bird Steam-Electric Station, Unit 1, The Montana Power Co., Billings, Montana

Steam Generating Equipment

Steam Generator (1) ..... Foster Wheeler Corp.
Single-drum, extended-surface type, 675,000 lb per hr maximum continuous capacity; 930-psig 905-F; boiler 17,780 sq ft; water walls 10,810 sq ft; superheater 18,730 sq ft; furnace volume 24,825 cu ft; heat release 19,900-Btu per hr per cu ft; superheat controlled from 425,000 to 675,000 lb per hr steam output; oil- and gas-fired; Peabody Engineering Corp. burners.

Air Preheaters (2) ..... The Air Preheater Corp.
Regenerative, 73,400 sq ft.

Forced-Draft Fan (1) .....
.....The Sturtevant Division, Westinghouse Electric Corp.
232,000 cfm, direct-coupled, 880 rpm, 17 in. static pressure, 100F.

Forced-Draft Fan Drive (1) ..... Elliott Co.
700 hp, 900 rpm, 2300-v, drip-proof, squirrel-cage motor

Induced Draft Fan (1) .....
.....The Sturtevant Division, Westinghouse Electric Corp.
383,000 cfm, direct-coupled, 490 rpm, 12.4 in. static pressure, 315F.

Induced-Draft Fan Drive (1) ..... Elliott Co.
1000-hp 514-rpm 2300-v, splash-proof, squirrel-cage motor.

Burner Oil Heaters (4) ..... American Locomotive Co.
4-pass, straight-tube, 120 to 210 F.

Fuel-Oil Burner Pumps (2)....(DeLaval) Turbine Equipment Co.
54,500 lb per hr, 225 psig.

Fuel-Oil Burner-Pump Drive (2) ..... Elliott Co.
25-hp, 1800-rpm, 440-v, drip-proof squirrel-cage motor.

Fuel-Oil Transfer-Pump (1) .....
.....(DeLaval)Turbine Equipment Co.
212,500 lb per hr, 75 psig.

Fuel-Oil Transfer-Pump Drive (1) ..... Elliott Co.
30-hp, 1200-rpm, 440-v, splash-proof squirrel-cage motor.

Water Columns (2) .....Diamond Power Specialty Corp.
Bi-color (1) and clear glass (1).

Main Feed Stop and Check Valves ....Chapman Valve Mfg. Co.

Blow-Off Valves ...Yarnall-Waring Co. and Edward Valves, Inc.

Power-Control Valves .....Manning, Maxwell & Moore, Inc.

Boiler Safety Valves ..... Foster Engineering Co.

Chemical Feed Equipment .....
.....(Milton Roy) Chemical Pump & Equipment Corp.

Feedwater Control System ..... Bailey Meter Co.

Combustion Control System ..... Bailey Meter Co.

Soot Blowers .....
.....Vulcan Soot Blower Div., Continental Fdry & Mach Co.

Fuel-Oil Tank Suction Heaters (3) Graham Manufacturing Co.

Turbine Generator Equipment

Turbine (1) ..... General Electric Co.
60,000 to 66,000-kw, AIEE-ASME Preferred Standard unit, 850 psig, 900 F, 3600 rpm.

Generator (1) ..... General Electric Co.
70,588-kva, 0.85-pf, 13,800-v, 3-phase, hydrogen-cooled; exciter 190 kw, 250 v, direct-connected; amplidyne automatic voltage regulator, Type GNA.

Condenser (1) .....Lummus Co.
37,500-sq ft, 2-pass deaerating-type; non-divided water boxes; 56,000-lb hotwell; arsenical Admiralty tubes; Muntz metal tube sheets.

Air Ejector (1) .....The Lummus Co.
Twin-element, 2-stage, 195-lb per hr air and vapor mixture, 61-lb per hr dry air; 850-psig 900-F steam.

Circulating-Water Pump (1) .....Ingersoll-Rand Co.
76-cfs single-stage mixed-flow, vertical-propeller type, 39 ft total dynamic head.

Circulating-Water Pump Drive (1) .....Elliott Co.
500-hp, 600-rpm, 2300-v, splash-proof, squirrel-cage motor.

Circulating-Water Butterfly Valve ..... R-S Products Corp.

Feedwater System

Condensate Pumps (1) .....Ingersoll-Rand Co.
750,000-lb per hr vertical centrifugal, 5-stage, 500 ft total dynamic head.

Condensate Pump Drives (2) ..... Elliott Co.
250-hp, 1800-rpm, 2300-v, drip-proof squirrel-cage motor.

Boiler Feed Pumps (2) Worthington Pump & Machinery Corp.
750,000-lb per hr horizontally-split centrifugal 6-stage, 2680-ft total dynamic head, 315 F.

Boiler Feed Pump Drives (2) .....Elliott Co.
1250-hp, 3600-rpm, 2300-v, drip-proof squirrel-cage motor.

Closed Extraction Feedwater Heaters (4)....Griscom-Russell Co.
No. 1 — 2480-sq ft, horizontal U-tube, 4-pass, copper tubes.
No. 2 — 2000-sq ft, horizontal U-tube, 2-pass, copper tubes.
No. 3 — 2145-sq ft, horizontal U-tube, 2-pass, 70-30 cupro-nickel tubes.
No. 4 — 1832-sq ft, horizontal U-tube, 2-pass, 70-30 cupro-nickel tubes.

Evaporator (1) .....The Lummus Co.
1550 sq ft, U-tube single-effect, 30,000-lb per hr vapor, 34.3 psia.

Evaporator Preheater (1) .....Hoppes Manufacturing Co.
Vertical, tray-type, deaerating capability 30,040 lb per hr of water at 0.03 cc of oxygen per liter; 22 cu ft storage.

Reverse-Current Valves .....Atwood & Morrill Co.

Evaporator Feedwater Treating Graver Water Conditioning Co.
(1) Sodium Zeolite softener, rated 800,000 lb.

Structural Equipment

Main Building Steel.....Midwest Steel & Iron Works Co.

Gantry Crane.....Whiting Corp.
Four-motor outdoor traveling crane, 35-ton main hook, 10-ton auxiliary hook.

Intake Screens, Guides and Accessories .....
.....Kansas City Structural Steel Co.

Passenger Elevator.....Otis Elevator Co.

Concrete Chimney.....The Rust Engineering Co.

Stairs, Grating, Louvers, Hand Railing and Miscellaneous Steel .....Kansas City Structural Steel Co.

Fuel-Oil Storage Tank, 80,000-bbl.....Chicago Bridge & Iron Co.

Fuel-Oil Day Tank, 5000-bbl.....Chicago Bridge & Iron Co.

Condensate Storage Tank.....Eaton Metal Products Co.

Circulating-Water Piping.....Kansas City Structural Steel Co.

Fuel-Oil Unloading Tank, 150 bbl.....Lacy Manufacturing Co.

Cooling-Water Tank.....The Lang Co.

Gland-Seal Tank.....Eaton Metal Products Co.

Electrical Equipment

Main Power Transformer (1).....General Electric Co.
82,500 kva; 115-13.8 kv; 3-phase; forced-oil and air-cooled.

Auxiliary Power Transformer (1) .....
.....Allis-Chalmers Manufacturing Co.
5,000-kva; 13.2-2.4-kv; 3-phase; self-cooled.

Auxiliary Switchgear.....Westinghouse Electric Corp.
4160-v, 600-a and 2000-a, 150-mva, drawout-type.

Load Centers and Motor Controls....Westinghouse Electric Corp.

Station Auxiliary Motors .....Elliott Co.

Boiler-Turbine-Generator Control Board.....Panellit, Inc.

Main Oil Circuit Breaker.....Allis-Chalmers Manufacturing Co.
14 400-v; 4000-a; 1500-mva.

Air Break and Disconnect Switches.....Delta-Star Electric Co.

Fibre Conduit and Fittings.....Graybar Electric Co.

Steel Conduit and Fittings.....Franklyn & Smith, Inc.

Power Control and Lighting Cable.....Simplex Wire & Cable Co.

Telephone Equipment.....Bell Telephone Co.

Grounding Cable .....Anaconda Wire & Cable Co.

Other Mechanical Equipment

Station Air Compressor and Motor Drive (1) .....
.....Gardner-Denver Co.
General service, 153 cfm; 7" x 5¾" x 5"; 100 psig, 870-rpm; built-in 40-hp, 900-rpm, 440-v drip-proof squirrel-cage motor.

Instrument Air Compressor (1).....Gardner-Denver Co.
Instrument service, 112 cfm; 8" x 9"; 100 psig, 325 rpm.

Instrument Air Compressor Drive (1).....Elliott Co.
25-hp, 1800-rpm, 440-v, drip-proof squirrel-cage motor.

Intermediate-Pressure Heater Drip Pumps (2) .....
.....Byron Jackson Co.
Vertical centrifugal 10-stage, 88, 780 lb per hr, 345 ft total dynamic head.

Intermediate-Pressure Heater Drip Pump Drives (2) .....
.....Elliott Co.
25-hp, 3600-rpm, 440-v drip-proof squirrel-cage motor.

Low-Pressure Heater Drip Pumps.....Goulds Pumps, Inc.
Horizontal centrifugal single-stage, 161,600-lb per hr; 40-ft total dynamic head.

Low-Pressure Heater Drip Pump Drives (2).....Elliott Co.
5-hp, 1800-rpm, 440-v, 3-phase, drip-proof squirrel-cage motor.

Pumps, Miscellaneous .....
.....Goulds Pumps, Inc., and Allis-Chalmers Mfg. Co.
Cooling Water (2); River-water booster (1); Sump (2); Evaporator Feed (2); Condensate transfer (1).

Power Piping and Hangers.....Grinnell Co.

Firing-Aisle Cubicle.....Panellit, Inc.

Station Heating Boiler .....
.....Combustion Engineering-Superheater, Inc

Unit Steam Heaters .....Trane Co.

Condensate Make-Up Heater.....Griscom-Russell Co.

Cast-Steel, Iron and Bronze Valves.....Reading, Pratt & Cady

Forged-Steel Valves.....Manning, Maxwell & Moore, Inc.

Pressure-Reducing Valve and Desuperheater .....
.....Northern Equipment Co.

Pressure and Level Control Valves.....Fisher Governor Co.

Rubber Expansion Joints.....Moisson Packing & Rubber Co.

Recorders.....Leeds & Northrup Co., Bailey Meter Co., and Minneapolis-Honeywell Regulator Co.

Pressure Gages .....
.....Helicoid Division (American Chain & Cable Co.)

Industrial Thermometers.....Manning, Maxwell & Moore, Inc.

Float Switches.....(Magnetrol) Energy Control Co.

Lube-Oil Purification Equipment.....Bowser, Inc.

Safety and Relief Valves.....Manning, Maxwell & Moore, Inc.

Chemical-Laboratory Furnishing and Equipment .....
.....Eimer & Amend Co.

Duplex River Water Strainer.....J. A. Zurn Manufacturing Co.

Cooling-System Heat Exchanger.....American Locomotive Co.

Motor-Operated Feedwater Regulator By-Pass Valve.....
.....Lunkenheimer Co.

Pneumatic Pressure Transmitters, Receiving Gage & Controllers.....Manning, Maxwell & Moore, Inc.

Pneumatic Temperature Transmitters.....Moore Products Co.

er as deficiency in condensate requires. Evaporator make-up is introduced into the low-intermediate-pressure heater.

Electrical and mechanical instruments are combined on a single, compact control board of functional design. Instruments are of miniature size, actuated hydraulically or by compressed air; no high-pressure lines are required in control room.

Generator main leads run beneath the turbine-room operating floor to the building wall, thence overhead on column supports to a circuit breaker serving an 82,500-kva main transformer. Generator main field circuit breaker and main exciter field rheostat are enclosed in cubicles, located under the generator pedestal. Main 2400-v station auxiliary power is obtained from main generator leads through a three-phase 5000-kva, 13, 200-2400-v transformer; 2400-v switchgear is of enclosed metal type. Station auxiliary power at 480 v is obtained from a 500-kva, 2400-480-v dry-type transformer. A connection from a nearby substation serves electric needs when the station is shut down.

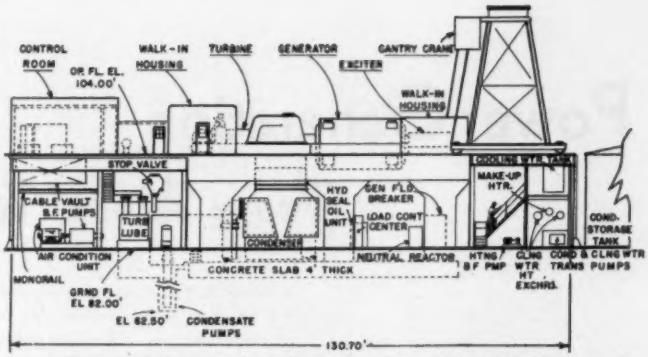


Fig. 5. Elevation of plant at right angles to that of Fig. 4, showing turbine generator with walk-in housings over turbine high-pressure end and exciter, gantry crane, control room—all on turbine deck at El. 104. Auxiliaries below in enclosed space. Concrete slab extends under most of plant

Ebasco Services, Incorporated, rendered engineering and construction services on the Frank Bird Steam-Electric Station.

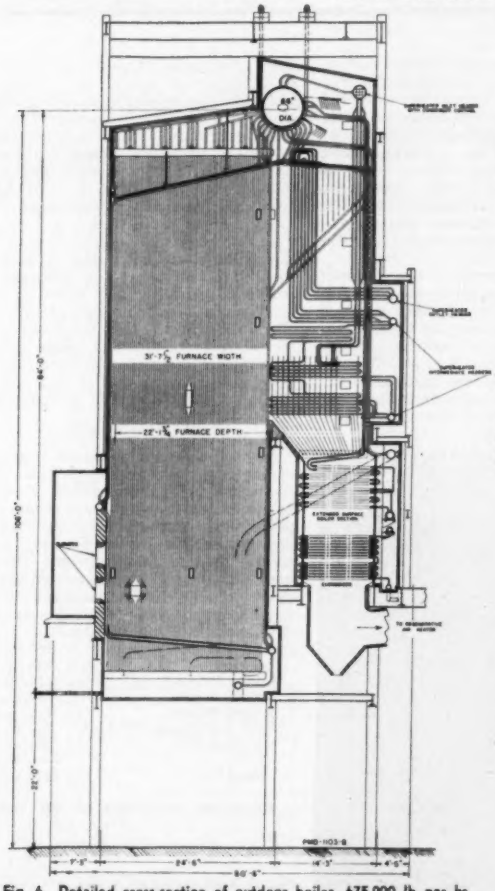


Fig. 6. Detailed cross-section of outdoor boiler, 675,000 lb per hr, 920 psig, 905 F (design pressure 1050 psia)

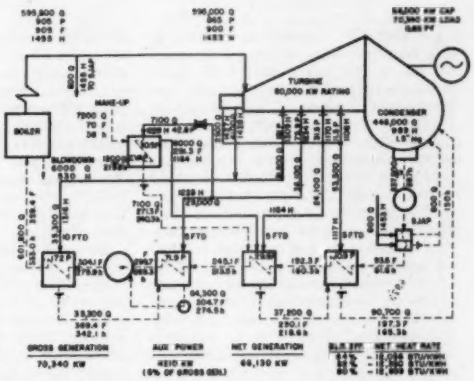


Fig. 7. Heat balance diagram for station at 70,340 kw gross generation. Q = flow in lb per hr; P = pressure in psia; F = temperature degrees F; h = heat of liquid, Btu per lb; H = total heat (enthalpy) of steam, Btu per lb

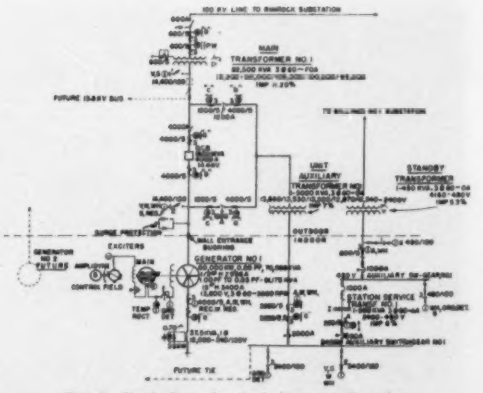


Fig. 8. Single line electrical diagram of station

Power Generation

From Wood Waste

A well-designed power plant, generating both steam for process and space heating and electric power, can make wood waste in a furniture factory an asset that can mean the difference between operating it at a profit or a loss. In this article, Mr. Gusler analyzes several types of plants to prove this point. Mr. Gusler concludes that it always pays to generate both steam and electric power provided *all* power is generated

By DENARD L. GUSLER

A PERSON visiting a furniture factory today after an absence of say thirty years would be very much surprised at the changes that have taken place. The old steam engine driven line shaft is gone and along with it the leather belt, the screw press, and many levers that had to be operated by hand. Instead there are core presses that glue together a continuous stream of wood. Hydraulic presses that automatically press and glue together a layer of panels in one operation. Completely conveyorized rough process mills so integrated that they operate as one enormous machine. Induction drying of glue is common as well as all manner of electronic control.

I well remember my first visit to a furniture factory some 26 years ago when I was seven years of age. This particular plant was a model of its day, employing electric motors on most of the machinery. Electric power was furnished by a belted generator. The four-foot-wide belt was driven by a 22-ft. diameter fly wheel operated by a Corliss valve gear reciprocating engine with a huge fly ball governor. Steam for the engine was generated in two hrt boilers. Negro firemen, stripped to the waist, fed scrap wood into the fiery furnaces.

Sometime after my visit the belt broke and wrapped around the fly wheel. The whipping belt tore off the roof of the engine room, then gathered together with a mighty whump in the fly wheel pit. The resultant lift broke the main and outboard bearings and brought to a sad end the struggle of this picturesque piece of machinery.

That the furniture factory has become so modern while the power plant remained obsolete is a constant source of amazement to me. The apparent reason is that disposal of wood waste has been considered a necessary evil to be squandered in any convenient means without regard to any economic factors that might be involved. It is to the credit of the plant management of many furniture factories of today that they have recognized the fact that wood waste is actually an asset that often can mean the difference between operating the plant at a profit or a loss. The general conclusion reached is that the most effective disposal of wood waste is in the efficient generation of steam and power. It is in support of this conclusion that this article is written.

Power Requirements

Since the economic considerations of any plant are always peculiar to the actual plant under study, it will be necessary to establish a standard plant. The standard plant will make it possible to relate the power plant to the factory without bias. The usual factory making bedroom and dining room furniture from veneered panels will require power in the amounts listed below:

Air Compressor	200 hp
Dry Kilns	120 hp
Rough Process	400 hp
Smooth Process	750 hp
Sanding Process	225 hp
Finish and Assembly Process	250 hp
Mill Exhausters	500 hp
Total	2445 hp

Assuming a voltage of 550, then

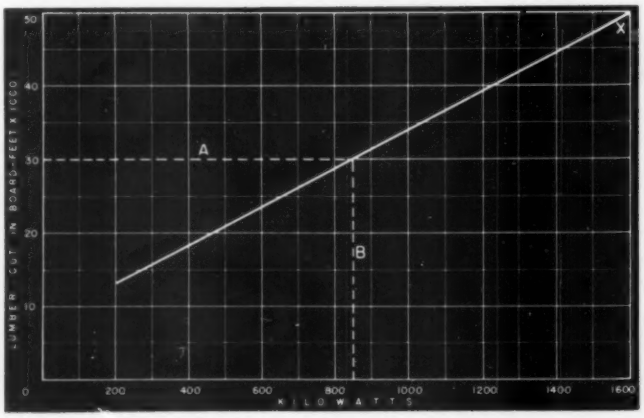


Fig. 1 Power required to run a furniture factory in terms of amount of board feet of lumber processed in an 8-hr day

one horsepower will about equal 1 ampere. Three phase current is always used. The kilowatt demand will thus be 2445 x 550 x 80%pf x 1.732 = 1860 kw. To this should be added 100 kw for lights and 40 kw for miscellaneous, making a total of 2000 kw. The load factor will be 67 per cent on the average which gives us an average load of 1500 kw.

In this standard factory all dimension stock is cut to suit. The rough process will cut from 30,000 to 50,000 board feet per eight hour day with the average running close to 40,000 board feet. This wood is made up of gum, oak, maple, poplar, tubelo, etc., and its weight will average three pounds per board foot. The lumber is dried to a moisture content of 7 per cent in an eight hour daily cycle. The heat value of the wood refuse per pound is 8500 Btu. Average waste is 65 per cent by weight. Available fuel as wood waste is then 40,000 x 3 x 65 per cent = 78,000 lb or 663,000,000 Btu. Many industries that have to buy their fuel would certainly like to have these Btus available for steam and power generation.

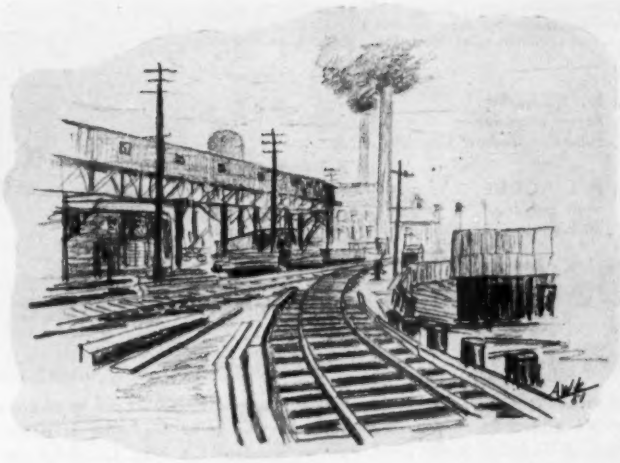
Six dry kilns will be necessary and the drying steam required for each kiln will be 2500 to 3000 lb per hr at 10 psi. Outside temperature will govern the steam demand to some extent. Using the average figure of 2750 lb per hr, the total Btu will amount to approximately 15,700,000. Process requirements will demand about 3000 lb of steam per hr or 2,850,000 Btu. For eight hours of operation the total steam demand will be 18,550,000 $\times$ 8 = 148,400,000 Btu.

Heating steam for the factory will vary from nothing in the summer months to as much as 20,000 lb per hr on a cold winter morning. It is apparant that the standard furniture factory should have a boiler plant capable of generating 1200 boiler horsepower or 40,000 lb of steam per hour.

Analysis of Power Plants

At this point we would do well to consider a factory that is served by an obsolete power plant. It has long been customary to gather all shavings and sawdust pneumatically at the machines and blow the refuse to dust collectors. The collectors are set above the boilers and the refuse is burned as fast as it is made. The boilers will pop off or the steam pressure will drop, depending on the amount of refuse coming from the factory. Sticks and blocks are loaded by hand at the machines where this type of refuse is made and trucked to the boiler room to be piled up for firing when the steam pressure drops or for heating at night during the winter months.

The power plant consists of 3 hrt boilers of 250 bhp generating steam at 150 psi. The steam goes to a steam engine of ancient vintage with a water rate of about 40 lb per kwh. This engine drives a 750-kw generator. Power that is not generated by the engine is purchased. Exhaust steam is used for process and heating. When there is not sufficient exhust steam it is supplemented through a reducing valve by high pressure steam. Frequently the boilers will be overloaded over 200 per cent. Efficiency will usually average about 50 per cent. That such plants can and do exist seems incredible. A plant of this type is described fully in the article "The Power Plant Improvement at Stanley Furniture Company" in the April, 1948, issue of *Power Generation*.



At a plant operated in the foregoing manner the following figures will be found reasonably accurate:

1. Current purchased per year averaging 900,000 kw.
2. Steam generated during heating season by burning wood and coal 300,000,000 lb per week maximum.
3. Coal purchased per year to supplement wood waste 1000 tons.

It was stated earlier that a cutting of 40,000 board feet per day would provide 663,000,000 Btu. At 50 per cent efficiency, assuming 240 deg feedwater and 150 psi, this amounts to 336,000 lb of steam per working day or 1,680,000 lb of steam per week.

At 1.25 cents per kwh, power will cost $11,250.00 per yr. At $9.00 per ton, coal will cost $9000.00. Total cost per year for coal and power will be $20,200. A cost that is difficult to estimate here is the physical labor necessary to move sticks and blocks

(Continued on page 118)

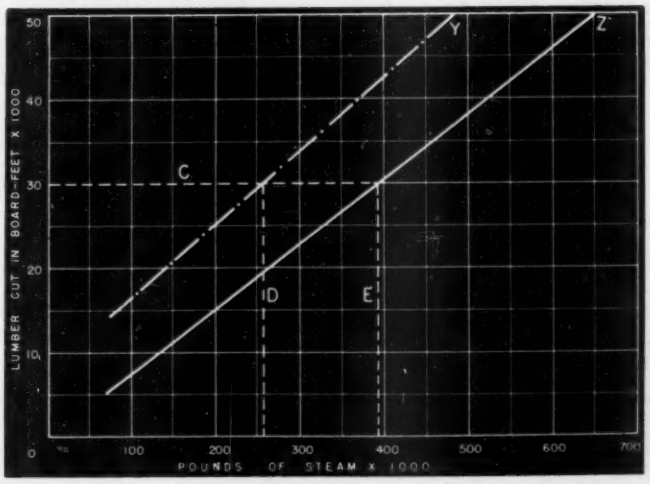


Fig. 2 Amount of steam required by furniture factory as a function of the number of board feet processed in an 8-hr day

Fig. 1. View of one of the three filters of Fig. 2, opened for cleaning, showing leaf-type construction. Filter screens roll out on trolley provided; spent filter cake is stripped into buggy below

By **W. A. SMITH**
Power Engineer
Pullman-Standard Car Mfg. Co.
and
F. L. HORINE
Staff Engineer
Johns-Manville Sales Corp.

De-Oiling Condensate for Boiler Feedwater

Oil reduced from 40 ppm to less than 0.1 ppm in 23,000 lb per hr of condensate added to oil-free condensate, forming boiler feedwater in power house of Haskell & Barker plant, Pullman Standard Car Mfg. Co., Michigan City, Indiana . . . Oil removed by using diatomite powder as adsorbent coating in leaf-type pressure filters . . . Details of equipment and operation described . . . Low costs, small space, minimum attention . . . Produces clear water; oil content less than limit of error in analysis; boilers clean

THIS LARGE Haskell & Barker plant of Pullman-Standard Car Mfg. Co. at Michigan City, Ind., makes only railroad freight cars. About five years ago, as part of a general economy, expansion and improvement campaign at this plant, two new William Bros 50,000-lb-per-hr, 400-psi, 750-F boilers, Fig. 3, were installed to meet additional power plant requirements. These units are fired with coal by Detroit Roto Grate spreader stokers. They replaced old low-pressure boilers, but two of the old 175-psi boilers are still in service, as stand-by.

Where the Condensate Comes From

The varied makeup of the condensate that must be returned to the two new boilers for boiler feed posed a problem, for this boiler feedwater must be oil-free for such service. The feedwater is from the following sources:

	40,000	lb per hr condensate from turbine generators
(winter)	50,000	lb per hr condensate from heating system
	23,000	lb per hr condensate from oil-contaminating sources
	7,000	lb per hr make-up water
Total	120,000	lb per hr

Make-up water is city water; it is hot lime and soda treated in the boiler house, clarified by a pressure Anthrafilt filter and released into the hot well as required. This process is automatic and carried out in equipment largely developed by the company. Into this hot well also return the other waters listed above. The turbine-generator condensate is oil-free. The heating system condensate is substantially oil-free but this is combined with all oil-contaminated condensate for treatment before return to the hot well. After being drawn from the hot well, the combined waters are deaerated before being fed to the boilers.

How Much Oil in Condensate?

As stated, oil must be removed from the 23,000-lb item before it can be fed to the boilers. This oil comes from a number of Corliss and Skinner engines driving air compressors, as well as from two 1500-psi hydraulic pumps and various power house reciprocating auxiliaries and forge shop equipment. It is desirable to use highly-compounded oils for lubricating much of this equipment. This fact, coupled with the service to which the steam is put, results in a condensate which in summer contains about 40 ppm of finely and tightly emulsified oil. In winter, the dilution of this water by the heating system condensate results in roughly doubling the amount of water to be de-oiled though halving the oil content. The pH of the oil bearing condensate may vary from 8.0 to 9.0 and the temperature from 140 to 190 F, depending upon the time of the year.

The condensate destined for the older 175-psi boilers was run through excelsior, which did far from a complete oil-removal job, but still good enough, for those boilers would tolerate a considerable feedwater oil content. No oil, however, could be tolerated by the new higher-pressure boilers.

For the old boilers, first alum and soda ash were used to form a floc, to trap the oil before the passage through the excelsior. But the boilers started priming—to the point of danger.

Analysis showed excess sulfates in the water. Sodium aluminate was then substituted for the soda ash. This cut the use of alum in half and reduced sulfates by one-half. But results were still poor and excessive blow-down was necessary to keep soluble sulfates within permissable limits. At first, the installation of a filter bed superior to excelsior was considered for the better removal of the alumina-oil floc. There were evident objections to this. Frequent and skilled chemical control would be required for proper floc formation, because of variations in both the condensate load and its oil content. Also, the equipment required would present a maintenance problem for the average operator.

Principles of Diatomite Adsorbent Method

Evidently a simpler and surer method than chemical coagulation was needed for the removal of both free and emulsified oil from the condensate. The plant's engineering staff studied among other things the method of using processed diatomite in conjunction with pressure leaf-type filters. The function of the treated diatomite powder is to adsorb all of the oil. The diatomite itself is insoluble and no pH control or chemicals are required. The filter, of course, retains the diatomite. This method was first employed by the Navy—notably upon escort carriers powered by Skinner Unaflow engines—and since then for de-oiling condensate generally where complete oil removal is essential. Both installation and operating costs are low and space requirement is small. Operator attention is kept to a minimum.

It was decided to install this process. Accordingly, three filters, of 40 sq ft of active filter area each, were obtained from the Blackburn-Smith Mfg. Co. These are shown in Fig. 2. They can be easily and quickly cleaned by swinging open the head and sliding out the filter screens upon a trolley designed for that purpose, as in Fig. 1. The spent diatomite filter cake containing the oil removed from the water during its passage through the filter is readily stripped off into a buggy. Figure 1 shows the leaf construction of this type of filter.

The diatomite used is Sorbo-Cel—a Johns-Manville product. It is a specially-processed, high-flow-rate, diatomaceous silica Celite powder that has the property of removing oil from water. Like other Celite powders, it is composed of diatoms—minute porous particles of varied shapes and sizes. From these tiny treated particles, Sorbo-Cel derives its ability to both adsorb and "trap out" emulsified oil globules when an aqueous suspension of these globules is passed through it.

How the New Diatomite Process Works

The operation of the process is essentially as follows:

1. The Precoat:—A special grade PreCoat Sorbo-Cel is used for depositing the initial coating upon the fine metal filter screen elements. The powder is suspended in water in a suitable vessel. By means of pump recirculation, the Sorbo-Cel is removed from suspension and deposited on the filter elements to form an even, porous coating over the entire surface. This "precoat" prevents the main filter cake, containing the removed oil globules, from coming into contact with the wire mesh of the filter elements and clogging them. The time required for this operation is from 5 to 10 min.

2. Main Body Filtration:—After the precoating has been completed, actual filtration is started. Recirculation is stopped and the unfiltered water is pumped into the filter press. As it passes through the precoat, all oil globules, together with any suspended matter, are trapped out by the microscopically porous diatomite particles.

In order to prevent a breakthrough of the oil, a predetermined amount of regular Sorbo-Cel is added continuously to the unfiltered water. This gradually builds up on the surface of the precoat, so that a new filtering surface is constantly being presented to the water to be filtered. In actual operation, continuous feeding is done by means of

Fig. 3. Two new 50,000-lb-per-hr, 400-psi, 750 F spreader-stoker-fired boilers at Haskell & Barker plant, for which de-oiled condensate forms part of boiler feedwater supply

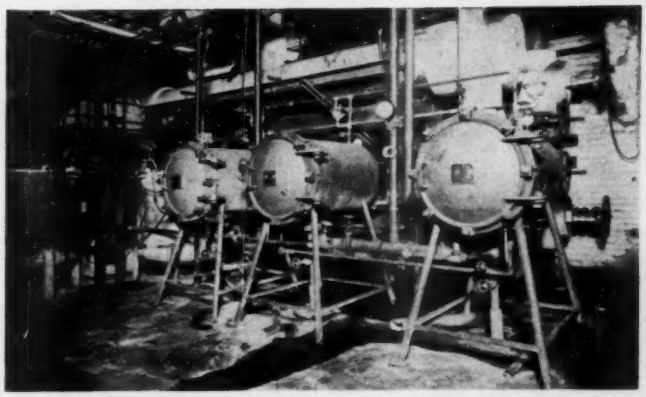


Fig. 2. Three 40-sq-ft leaf-type filters for de-oiling condensate at Haskell & Barker plant

a Madden proportioning pump, which is set at a given flow and feeds a Sorbo-Cel slurry into the filter inlet line.

3. Equipment:—Unfiltered condensate receiving tank—6-ft by 4-ft by 6-ft steel tank. Some free oil readily separates out in this tank. It is provided with a float valve, which actuates a valve in the filter outlet manifold so that filtered condensate is returned to it if the level in it falls to a certain point. This is to prevent loss of flow to the filters in case the rate of supply of unfiltered condensate becomes too low. Loss of flow in the filters might result in the filter cake falling from the screens, the effect of which would be to permit oil bearing condensate to pass through into the oil-free water collection tank.

Oil-free water receiving tank—6-ft by 6-ft by 5-ft steel tank. This tank acts as intermediate storage between the filters and the hot well.

Filters—3 Blackburn-Smith Mfg. Co.—40 sq ft each. Each is provided with an automatic air release trap.

Precoating and filter pumps—each 120 gpm at 75-ft head.

Sorbo-Cel water suspension injection pump 0.15 gpm; P. E. Madden.

Precoat & Main Body Sorbo-Cel feed tanks—3-ft dia. by 4-ft vertical—mechanically agitated.

4. Operation: — The precoating tank is charged with 20 lb Precoat Sorbo-Cel and the main body feed tank with 14 lb regular Sorbo-Cel. The charge in the precoat tank is circulated through a filter and back to the tank. In a matter of minutes, the precoat material has been deposited upon the fine metal screen filter leaves as a porous cake or bed about 1/3 in. thick. The outlet valve under the unfiltered condensate supply tank is then opened and the precoat tank outlet valve closed.

At the same time, the filtrate is diverted to the oil-free water receiving tank and the Madden pump put into operation in order that a continuing supply of Sorbo-Cel may be fed to the oily condensate entering the filter. The filter is now in operation and will run for a week without further attention, except that twice a day the slurry supply in the main body feed tank must be replenished. Sorbo-Cel from that tank is added at the rate of 2 in. per hr, though the feed rate can be varied to match load demand.

Results of New Filtering Method

One advantage of this process is that an *excess* of diatomite powder is not detrimental. In fact, the process is based upon the normal use of a slight excess—a fact which enables unexpected peaks to be handled without attention.

The normal summer flow through the filter is about 1/3 gal per sq ft per min, but this will about double in the winter.

After a week's operation, the filter cake is about 1 in. thick and the space between the filter leaves almost full. The filter body is then drained, the head opened, the leaves pulled forward and the cakes removed to waste. The leaves are then hosed down with hot water, the filter reassembled and put back into service. Of interest is the fact that, though the diatomite has adsorbed about one-half its own weight of oil, the water wet filter cake shows no evidence of its oil content.

The filtered water is brilliantly clear during the entire cycle. Determination of its oil content is very difficult because the actual oil content is less than the limit of error in the usual analytical methods. That the water contains less than 0.1 ppm of oil is a conservative statement.

Since the diatomite filters have been installed, the boilers have been operated upon a 1 per cent blowdown basis. By law, they must be shut down twice a year for inspection and repair. Tubes show a remarkable degree of cleanliness—no sign of scale or blister, oil or otherwise; and no reaming or tube replacement has been necessary.

Fig. 1. View of a well-designed, well-equipped power plant laboratory for routine chemical analyses of water and lubricating oil

A Power Plant Laboratory

Best location . . . Type of construction . . . Lighting and ventilation . . . Laboratory furniture and equipment . . . Routine chemical analyses . . . Lubricating Oil Analyses . . . Major laboratory equipment, arrangement . . . Supplies . . . Estimate of costs

By S. M. SPERRY
Chief Chemist, Gilbert Associates, Inc., Reading, Pa.

A POWER PLANT LABORATORY suitable for making daily analyses of water and turbine lubricating oil and any special analyses should be located in a well-ventilated room and free from dirt and excessive vibrations. The size of the room should be about 30 ft long by 15 ft wide and 10 ft high. The floor should be of concrete and covered with 9 in. by 9 in. asphalt tile, preferably of a light color.

It is desirable that a laboratory be located in a corner room where light can be obtained from two different sources. Every laboratory should have ample natural light. Window sills should be high enough to be flush with or above the counter top of the equipment which may be placed in front of them.

Very satisfactory results have been obtained with fluorescent lights, properly spaced to eliminate any shadows, especially where it is necessary to perform the daily water titrations. The light intensity should be approximately 75 ft candles. The standard cool white light has given the best results.

While natural ventilation is desirable, it is perhaps more desirable to depend upon a mechanical means of ventilating the room. Unit ventilators placed under several window sills bring in outside air in any desired proportion, filter this air and heat it to the required room temperature. An additional refinement to this is the air conditioning unit which performs the same function as a unit ventilator but also cools the air in summertime. These and the unit ventilators are self-contained units and do not require expensive duct work from a central source.

Walls may be plastered and painted, but from a sanitary and maintenance point of view a structural glazed tile wall run to the ceiling is more desirable. All corners should be bullnosed. A cove tile base of a dark color aids in cleaning. Structural glazed tile may be obtained in various colors. Generally, the atmosphere in a laboratory should be bright, cheerful and colorful.

Although the sound decibel within the laboratory is not high, it is desirable to have a ceiling of acoustical tile. This helps to deaden outside noises.

Figs. 1 and 4 show photographs of

In our December 1950 issue we published a plea for help in designing and equipping a power plant laboratory for the routine analyses of water and lubricating oil. This was an actual request by a reader who has been a subscriber since 1926. It was his job to design and build a laboratory for the testing of feedwater for the boilers and analysis of lubricating oil. Evidently, this request struck a sympathetic chord, for a number of readers immediately indicated their desire to prepare an article describing such a laboratory. This splendid description by Mr. Sperry of the Gilbert organization is one of several articles we have received so far but there are others coming. This laboratory described by Mr. Sperry is, of course, a very well equipped one and highly suited to the medium and large size plant. There are, however, many smaller plants which could not justify so elaborate a laboratory and so, in future issues, we will present descriptions of more modest ones for use with smaller power plants. We know you will enjoy reading about all of them.

seven recent laboratory installations suitable for water and oil analyses.

Laboratory Furniture

The furniture to be installed in the laboratory should include a center table, sinks, a wall table, fume hood, storage cabinet, etc., all of metal construction. Detailed specifications of each of these follow.

Center Table

The laboratory center table should be approximately 15 ft in length, 4 ft 6 in. in width and 3 ft in height. A permanent burette stand should be provided as illustrated upon the drawing, Fig 3.

The manufacturer of the table should make provision in the top to permit the passage of ⅜ in. diameter glass tubing from solution reservoirs located beneath the bench top to three-way burettes mounted upon the stand. Suitable interior shelving should be provided to support one liter reagent bottles to serve each burette. A white Carrara glass plate should be furnished beneath the burettes and extending the full length of the burette stand, and should be recessed flush with the table top. Hot and cold water should be piped to the sinks and discharged through a duplex fitting and a cold water line should extend the length of the bench beneath the shelf reagent rack. A vacuum line should also be provided beneath the reagent shelf and the end cabinet should have a removable bottom to permit installation of a rotary air blast and suction apparatus.

Outlets from this line should be provided at each extremity and at the center of the bench and facing each side—a total of six outlets. There should be provided conduit and outlets for 120 single phase electrical service running beneath the reagent shelf with plug sockets at each extremity and in the center of the table.

Each end of the shelf reagent rack above the sinks should be suitable for mounting a five-gallon Pyrex distilled water reservoir. A fluorescent light should extend the length of the burette stand beneath the reagent shelf and should be shaded to throw light to the working surface and away from the face of the analyst.

The working surface of the table should be fabricated from 1¼ in. Alberene stone or equivalent non-staining smooth working surface. The under-section of the table should be finished in a color which will harmonize with the walls and floor. Metal furniture finished in either a light or dark green is often recommended.

Laboratory Sinks

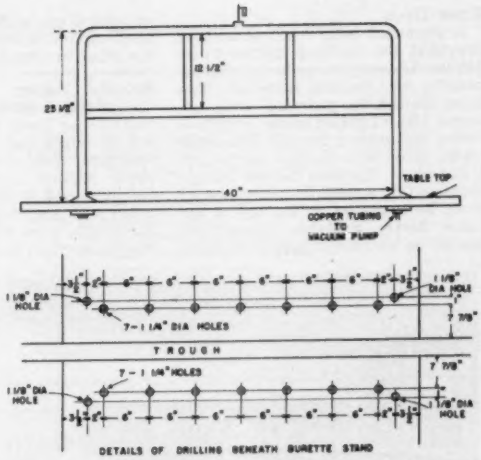
A sink should be provided at each end of the bench as shown in Fig. 3. These sinks should be fabricated from 1¼ in. Alberene stone or equivalent non-staining smooth material and should be provided with integral drain boards sloping toward the sink. The sinks should be set against the end of the bench and the bench trough should penetrate the back of one sink. Hot and cold water should be supplied to the sinks through a duplex fitting, as described above.

The surfaces beneath the sinks at the front and sides should be enclosed with material of the same appearance and finish as the remainder of the table. The sinks should be approximately 20 in. in length, 12 in. in width and 12 in. in depth and should be complete with overflow and trap.

Wall Table

There should be a work table 2 ft 6 in. in width and approximately 12 ft in length, depending upon the size of the room, as shown in Fig. 3. The top of the table should be fabricated of the same material as the top of the center table and the finish of the vertical surfaces should match the finish upon similar parts of the other furniture. A balance table should be provided as a section of the wall table, at the end opposite the fume hood. This section should have no enclosed underspace. The work bench should be 3 ft in height to match the height of the center table. The remaining under-section of the wall table should be enclosed and equipped with doors and drawers suitable for storing laboratory glassware and equipment. A plug mold with outlets on twelve-inch centers should be mounted about 12 in. above the table top.

Fig. 2 Constructional details of a permanent burette stand



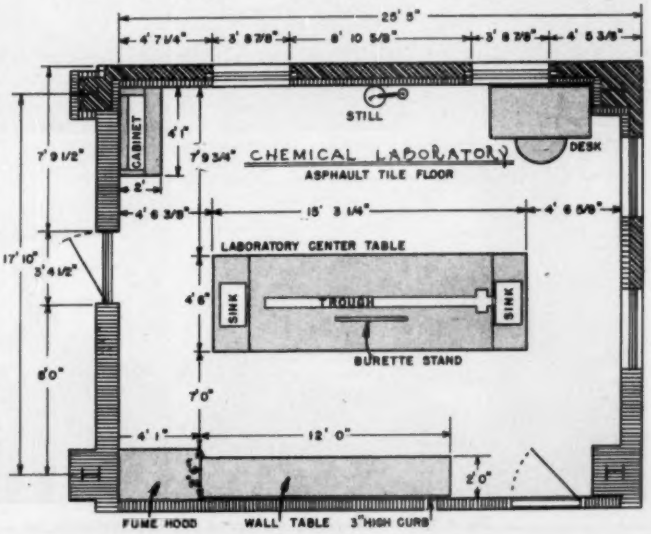


Fig. 3 Plan of the laboratory shown in Fig. 1

Fume Hood

A chemical fume hood should be provided, the working surface to be 1¼ in. Alberene stone or equivalent smooth non-staining material. The hood should be provided with internal 120-v lighting circuit and provision and outlets for 120/208 single phase three wire electric service for a hot plate. Suitable blower equipment with standard 120-v motor must be mounted at the top of the fume hood. Suitable connections should be installed to supply artificial or natural gas in the fume hood. The finish should match similar parts of the other furniture.

Storage Cabinet

A storage cabinet should be provided. The lower section should be 3 ft in height and 4 ft in width and equipped with drawers, while the upper section should be 4 ft in height and 4 ft in width and provided with shelving and glass doors. The finish upon this cabinet should match the other items.

Miscellaneous Furniture

Laboratory Desk—A standard metal desk finished in the same color as all other furniture should be provided.

Chairs—A desk chair should be provided with the desk, as well as one guest chair of suitable type.

Filing Cabinet—A standard four-drawer metal filing cabinet should be supplied for storage of all necessary laboratory records.

Laboratory Truck—A commercial

(Text continued on page 120)

Fig. 4 Views of six recently constructed chemical laboratories for water and oil analyses

List of Laboratory Equipment, Glassware and Supplies Needed

MAJOR LABORATORY EQUIPMENT

WATER ANALYSIS

1—Photoelectric Colorimeter, with accessories
1—Indicating Conductivity Instrument complete with cells
1—A.C. Electric pH Meter complete with electrodes
1—Colorimetric Hydrogen Ion Comparator
1—Colorimetric Phosphate Comparator
1—Colorimetric Nitrate Comparator
1—Microscope, Bausch & Lomb
1—Analytical Balance with weights
1—Torsion Balance with weights
1—Heater, Infra-Radiator
1—Constant Temperature Drying Oven
1—Electrically heated Water Bath, four openings
1—Electric Hot Plate, three-heat, 12 in. x 12 in.
1—Muffle Furnace, electric
1—Jackson Turbidimeter
1—Electric Water Still with storage tank

LUBRICATING OIL ANALYSIS

1—ASTM Union Colorimeter
1—Saybolt Thermostatic Viscosimeter
1—ASTM Water Determination Apparatus
1—ASTM Cleveland Open Tester
1—Electric Centrifuge
1—ASTM Steam Emulsion Apparatus
1—Cenco-duNouy Tensiometer
1—set Hydrometers, 0.700 to 2.00 sp gr
1—ASTM Carbon Residue Equipment

LABORATORY GLASSWARE AND SUPPLIES

Apron, laboratory		1
Beaker, Pyrex, 50 ml		6
Beaker, Pyrex, 100 ml		12
Beaker, Pyrex, 250 ml		12
Beaker, Pyrex, 500 ml		12
Beaker, Pyrex, 1000 ml		6
Bottle, dropping, 60 ml clear		4
Bottle, dropping, 60 ml amber		4
Bottle, flint, 250 ml		12
Bottle, flint, 500 ml		12
Bottle, flint, 1000 ml		12
Bottle, hardness, 250 ml Pyrex		6
Bottle, Pyrex, 500 ml GS		6
Bottle, Pyrex, 500 ml stoppered		12
Bottle, Pyrex, 1000 ml		6
Bottle, Pyrex, 5 gal.		2
Bottle, Reagent, Pyrex GS		6
Bottle, rubber, 500 ml		6
Bottle, wash, Pyrex, 1000 ml		2
Bottle, weighing		3
Brush, balance, Camel's Hair		1
Brush, beaker		2
Brush, burette, 36" long		1
Brush, Camel's Hair, 1" width		1
Brush, test tube		2
Burette, Exax, 10 ml, grad. 0.05 ml		2
Burette, Exax, 50 ml		2
Burette, 3-way, Pyrex, 50 ml		6
Burette Cap		12
Burette Funnel		4
Burette Stand, Fisher with holder		1
Burner, Fisher, with halo		1
Candle, turbidity		2
Casserole, titrating, #3, 140 ml		6
Casserole, titrating, #4, 340 ml		6
Clamp, burette, Fisher Castaloy		14
Clamp, Day's, pinchcock		12
Corks, #3-4-5-6-7-8-9-10-11		12 each
Cork Borer		1
Cork Borer Sharpener		1
Crucible, Coors porcelain, #0		12
Cylinder, grad., 10 ml		2
Cylinder, grad., 25 ml Pyrex Redline		2
Cylinder, grad., 50 ml Pyrex Redline		2
Cylinder, grad., 100 ml Pyrex Redline		2
Cylinder, grad., 250 ml		2
Cylinder, grad., 500 ml		2
Cylinder, not grad., 250 ml		2
Desiccator, 250 mm		2
Dish, Coors porcelain, #2, 120 ml		6
Dish, Coors porcelain, #765 ml		2
File, 3-cornered		2
Filter Paper, Whatman #1, 12.5 cm	pks.	6
Filter Paper, Whatman #1, 15.0 cm	pks.	6
Filter Paper, Whatman #40, 12.5 cm		6
Flask, Erlenmeyer, 125 ml		6
Flask, Erlenmeyer, 250 ml		6
Flask, Erlenmeyer, 500 ml		3
Flask, vol., Pyrex, 100 ml stoppered		3
Flask, vol., Pyrex, 250 ml stoppered		3
Flask, vol., Pyrex, 500 ml stoppered		3
Flask, vol., Pyrex, 1000 ml stoppered		3
Flask, vol., Pyrex, 2000 ml stoppered		3
Funnel, flint, 4"		1
Funnel, flint, 6"		1
Funnel, Pyrex, fluted, 3"		12
Funnel Support, 4 funnel, with stand		1
Glass Tubing, soda-lime, 7 mm	lb	2
Glass Tubing, soda-lime, 9 mm	lb	2
Hydrometer, brine		2
Hydrometer Cylinder for brine		2
Lubriseal, tube		1
Magnet		1
Magnifier		1
Mortar and Pestle, 50 mm		1
Nessler Tube, 50 ml matched set		3
Nessler Tube Support, 50 ml		3
Oxygen Sampling Equipment, complete		3
Pencil, wax, China marking		2
Pipette, Pyrex, 1 ml, 0.01 grad.		2
Pipette, Mohr, 10 ml, 1/10 ml grad.		2
Pipette, Exax, 1 ml		6
Pipette, Exax, 2 ml		6
Pipette, Exax, 3 ml		3
Pipette, Exax, 4 ml		2
Pipette, Exax, 5 ml		3
Pipette, Exax, 10 ml		3
Pipette, Exax, 15 ml		3
Pipette, Exax, 20 ml		3
Pipette, Exax, 25 ml		3
Pipette, Exax, 50 ml		3
Pipette, Exax, 100 ml		2
Pipette Rack, metal		1
Rubber Policeman		3
Rubber Stoppers, #0 to #9, inc.	ea.	12
Rubber Stopper, #12		3
Rubber Tubing, 3/16" ID LW	ft	25
Rubber Tubing, 3/16" ID HW	ft	25
Rubber Tubing, 1/4" ID LW	ft	25
Rubber Tubing, 1/4" ID HW	ft	25
Rubber Tubing, 3/8" ID LW	ft	25
Rubber Tubing, 3/8" ID HW	ft	25
Rubber Tubing Stretcher		1
Spatula, 6-in.		2
Spoon, horn or porcelain		2
Stirring Rods, glass		12
Test Papers for pH		1
Test Tube		12
Test Tube Marker		36
Thermometer, -40 to 120 F		2
Armor for Above		2
Thermometer, 0 to 220 F		2
Armor for Above		2
Thermometer, 0 to 150 C		2
Tongs, Beaker		1
Tongs, Crucible		1
Triangles, Nichrome steel covered		3
Watch Glass, 100 ml		12
Watch Glass, 200 ml		12
Wire Gauze Square, 6 x 6		6

Rehabilitation and Extension of the Narrows Power Plant of The Virginian Railway Company

History and description of the steam electric power plant built in 1925 to serve the electrified Virginian Railway Company system in Virginia and West Virginia together with an account of its rehabilitation and extension in 1945. Installation of new large capacity boiler and another 10,000 kw generator now enables plant to meet the greatly increased load demands at high efficiency

By C. O. LENZ Gibbs & Hill, Inc., New York, N.Y.

THE VIRGINIAN RAILWAY extends from Deepwater, W. Va., at the head of navigation on the Kanawha River to Sewall's Point at Hampton Roads, W. Va., a distance of 443 miles. It traverses the Pocahantas Winding Gulf and New River districts of the semi-bituminous coal fields, and taps a portion of the Kanawha district of the high volatile coal fields. The road was built primarily to transport coal from the mines to tidewater and other points for distant delivery.

From the beginning of operation until 1925-26, Standard and Mallet type steam locomotives were used exclusively as motive power. At Elmore, W. Va., the assembling point for eastbound tonnage, trains were made up of 5600 tons trailing weight for summer loading. These trains were hauled over the heavy grades to Clarks Gap by a Mallet type coal engine and two Mallet pushers. From Clarks Gap to Princeton the train was hauled with one Mallet road engine. At Princeton the train was augmented to 8500 tons, summer loading, 6000 tons in winter for the run to Roanoke. The power for this movement was one U. S. Mallet type road engine with a pusher out of Princeton yard, and a helper on the ten mile grade, Whitehorne to Merrimac.

Fig. 1. General view of the Narrows Plant of The Virginia Electric Railway Co.

This operating procedure at best was slow, requiring 3½ hr for a 36-mile run. From Princeton to Roanoke the time was 11 to 12 hr, at a speed of 8 miles per hr. Westbound service is entirely empty car movement.

As time passed, the increase in tonnage on the Virginian Railway called for more and heavier trains which demanded more expensive motive power and slowed down the running time of a single track railroad. Also, it increased the ton mile cost of operation. Due to all the inherent variables in steam locomotive service—congestion, delays, especially in bad weather and at times of heavy business—it became apparent to the management that provision for additional facilities was imperative. Exhaustive study finally indicated that electric traction offered the best solution for overcoming all of the difficulties arising from steam locomotive operation, particularly over the mountain division.

Electrification Started in 1924

Early in 1923, Gibbs & Hill, Consulting Engineers, were authorized by the Virginian Railway Co. to proceed with the electrification program from Mullens to Roanoke, a distance of 134 miles, covering full engineering and construction service. The service included the construction of:

1. The Power House, a source of primary power to satisfy the normal demands as well as short period

demands which fluctuate greatly with relay capacity.

2. The Electrical Transmission System, to transmit electrical energy at high voltage to points on the railway from which it could be economically distributed.

3. The Distribution System, to substations at suitable points to transform the electrical energy to the voltage required for trolley, to furnish current for the locomotives, feeders, track bonding, etc.

each rated at 125,000 lb per hr, supplying steam to four 10,000-kw turbo-generators, generating 25-cycle 3-phase current at 11,000 v. The boilers were fired with pulverized coal from a bin system. For transmission to the substations along the railroad, the voltage was stepped up to 88,000 v by means of four single phase transformers.

This power plant operated under natural draft. There were, and still are, two stacks, each 25 ft, 8 in. outported the pulverized coal and air from the mills to cyclone collectors. From the collectors, the coal was delivered, by two screw conveyors, for transport to any of six pulverized coal bins. An extra bin was provided for a future (No. 6) boiler.

During the business depression beginning in 1931, and continuing for several years, the load on the power plant was materially reduced, and many items of maintenance were deferred. This depression period

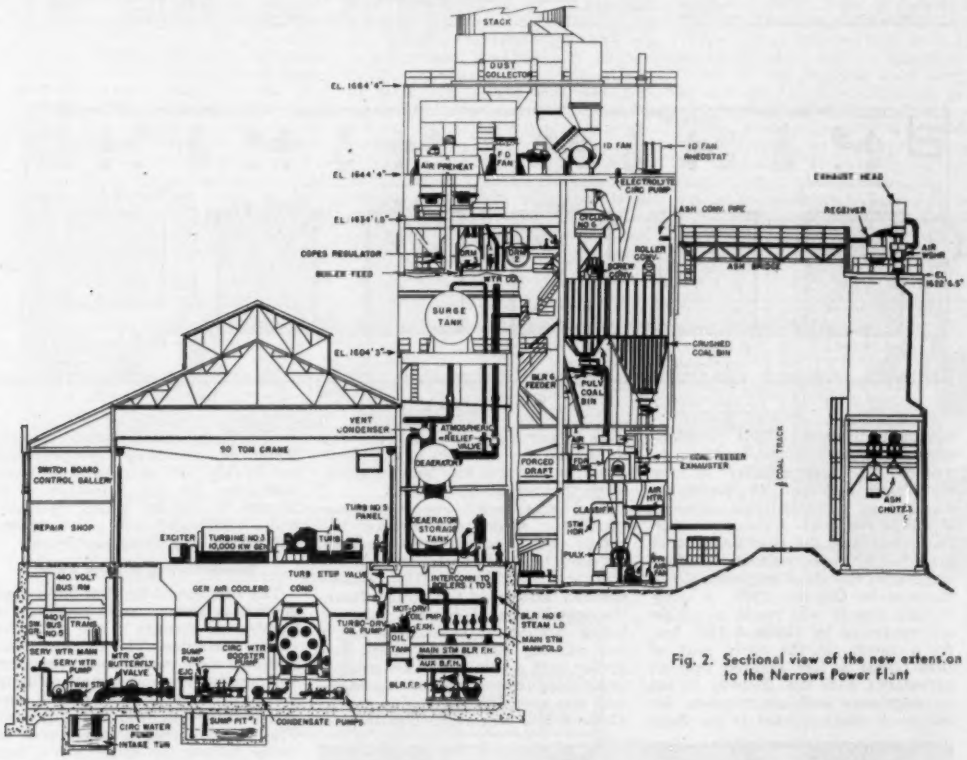


Fig. 2. Sectional view of the new extension to the Narrows Power Plant

4. The Locomotives. A suitable number of proper type and capacity to meet the requirements of service.

The Original Narrows Plant

Preliminary work began in 1924 and by 1926 construction was practically complete. The electrified zone, Mullens to Roanoke, was in continuous operation, supplied with electric power from the Narrows Power Plant.

The general design of the Narrows Power Plant is shown in the accompanying drawings. These show the layout of the original plant built in 1925 and also the addition made in 1946. Originally, the plant contained 5 cross-drum, sectional header, Springfield, water tube boilers, operating at 325 psig, 640 F, side diameter at the base and 16½ ft at the top. They are 285 ft high from the roof mats and 376 ft high from the bottom of the ash pits. All 5 boilers discharged into a common breeching located horizontally at the rear and above the boilers but there was a bulkhead in the breeching between boilers 3 and 4 so that in effect, there were two breechings.

The furnaces of these 5 boilers were vertically fired by 10 Lopulco pulverized coal burners, the latter supplied by six 5-ton per hr 6-roll Raymond mills with integral feeders, and operating without preheated air. The mills were installed in the basement. These Raymond mills have now been replaced by Foster Wheeler ball mills. Six exhausters, one for each mill, transwas followed by a rapid pick-up in business, accompanied by a scarcity of skilled labor. This brought about a general deterioration of power plant equipment. By stepping up the essential maintenance, however, and by increasing the maintenance force, the plant continued to meet the requirements of the road.

The year 1944, however, disclosed maximum instantaneous peak loads and maximum 5 min peak loads in excess of the (then) firm capacity of the plant. Also, the addition of four new locomotives then on order, it was estimated, would increase the peak loads by 20 per cent over the record performance of 1944.

In July 1945, the management of the Virginian Railway Co. engaged professional services to make a sur-

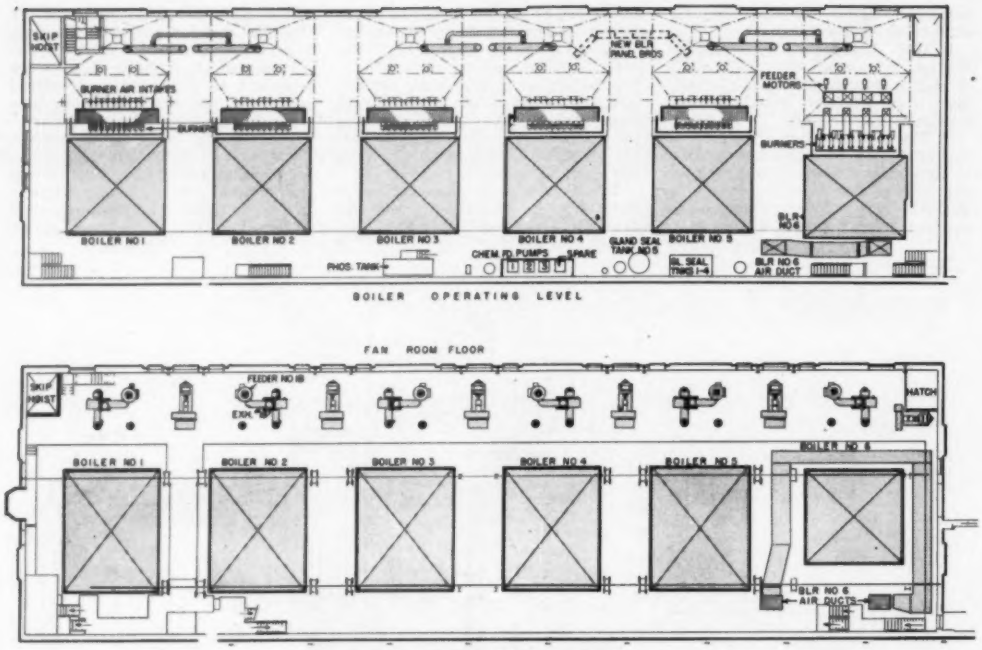


Fig. 3. Plan view of the boiler room

vey of the Narrows Plant to determine what steps should be taken to restore the dependability of the equipment and also to determine whether or not additional capacity would be required. A detailed study was made and the resulting report prepared by the consultants was forwarded to the chief engineer of the Railway in October 1945. A copy of this report was made available and reviewed by Gibbs & Hill, Inc. As a result, in the early part of 1946 Gibbs & Hill entered into an agreement with the Railway to act as engineers and constructors for the work contemplated at the Narrows Power Plant. This service was to include any addition to the plant capacity and also any rehabilitation work that might be needed.

The consultant's report recommended a steam accumulator together with a small high-pressure charging boiler, but after an exhaustive study Gibbs & Hill recommended, instead of the accumulator, the installation of a large capacity boiler similar in characteristics to the existing Springfield units, together with a new 10,000-kw electric generating unit. This recommendation was accepted and in due course Gibbs & Hill was authorized to proceed with the rehabilitation and addition. Specifications were prepared and in July 1947 arrangements were completed for the purchase of a 200,000 lb per hr, Foster Wheeler boiler with accessories and complete pulverized coal firing equipment.

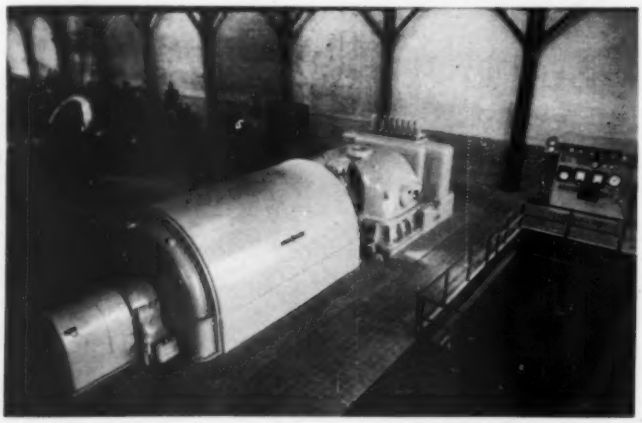


Fig. 4. A view of the new 10,000 kw generating unit

Rehabilitating the Old Plant

The addition of the new boiler and electric generator made necessary a number of changes in the structure of the buildings. The existing steel columns were inadequate to support the new boiler so new steel columns were provided and the existing ones were either removed or reinforced. The existing roof was removed in order to provide space for a new fan house at a higher level. Temporary shoring was necessary to support the existing building during construction of the new fan house, and, as described later in this article, precautions had to be taken in making new flue connections to the stacks. All the rehabilitation and new construction work had to be done without interruption of the existing equipment.

The original boiler house contained 6 crushed coal bunkers and 6 powdered coal bunkers. The capacity of the latter was approximately 130 tons each and the crushed coal bins were a trifle less, around 120 tons each. Over the years these bunkers had become

badly corroded and required rehabilitation. Structural steel members were also corroded and were either replaced by new members or additional ones were provided. To prevent further corrosion the entire inside surface of the bunkers were gunited. Finally, powdered coal bunker No. 6, now needed to supply the Foster Wheeler boiler, was modified and reduced in capacity in order to make room to properly install the pulverized coal feeders for this unit.

At the same time, the turbine room structure was extended east approximately 56 ft by the full width of the existing building, approximately 115 ft. This additional space provides ample room for the deaerating heater, storage tank and boiler feed pumps as well as the new General Electric 10,000-kw generating unit and auxiliary equipment. The foundations for this extension were carried down to rock, similar to those of the existing turbine room. The intake and discharge condensing water tunnels to serve the C. H. Wheeler condenser of the new unit were also extended.

The New Boiler

The new boiler is rated as having a continuous steaming capacity of 200,000 lb per hr and a maximum capacity of 225,000 lb per hr for 2 hr following continuous capacity operation. It is designed for 400 psig working pressure. It is equipped with a completely water-cooled furnace, superheater, air heater, and arranged for pulverized coal firing. The unit is fired by 8 vertical venting type burners installed in the furnace arch and supplied from 4 pulverized coal feeders of the double discharge type. Secondary air ports are located in the furnace front wall.

The vertical venting type burners were developed for firing pulverized anthracite or other low volatile coals. Each burner consists of a cyclone separator complete with individual vent nozzle and firing nozzle. Incoming coal enters the cyclone and the amount of vented air is regulated manually by control dampers in the vent liner.

Since the 5-minute peak steaming capacity imposed on the Narrows plant is around 400,000 lb, the new boiler, it was anticipated, would have to take a large part of these swings, hence particular attention was given the settings and baffles.

The general arrangement of the equipment in the new part of the boiler room is indicated in Figs. 2 and 3. This section shows the two coal bunkers side by side above the operating floor. Raw coal falls by gravity into the pulverizing mills. Three Foster Wheeler Ball mills are provided, each with a capacity of 30,000 lb per hr, and each driven by 325 rpm, 3-phase, 25 cycle G-E Motors through Falk flexible couplings. Each pulverizer is provided with an American Blower Co. steam air preheater for supplying preheated air to the mill and the bypass to the exhauster. Each mill has two exhausters installed directly above the mills as shown. From the exhausters, the coal and air mix-

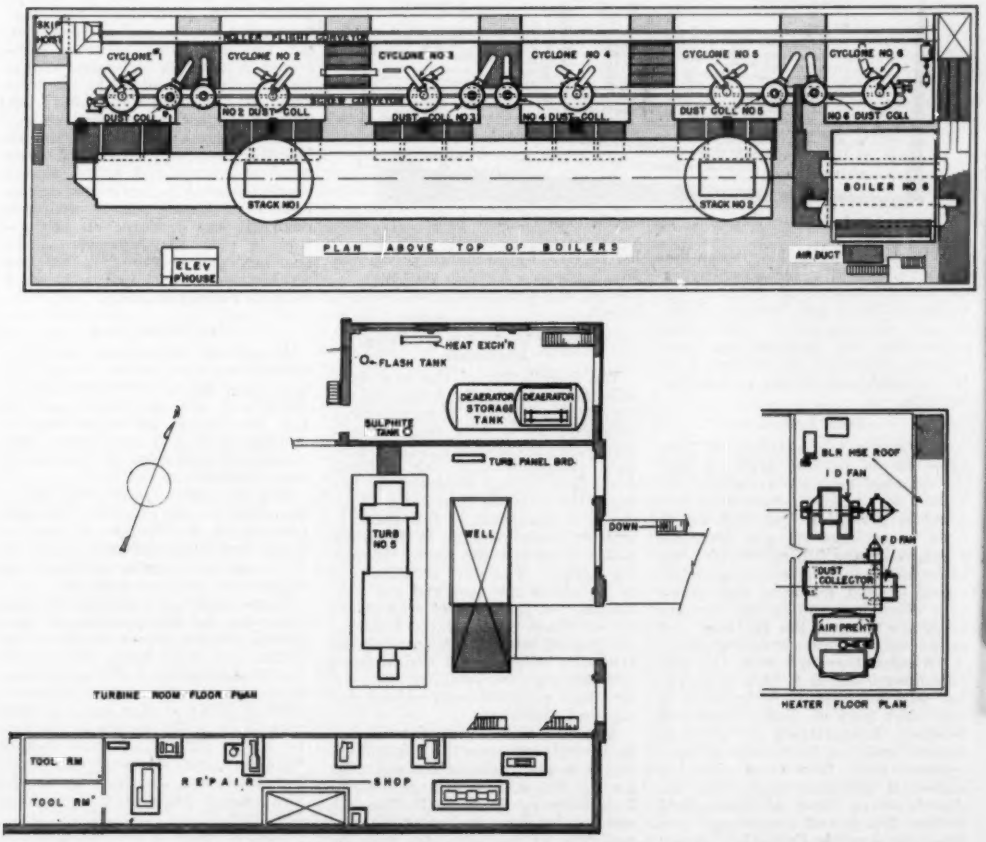


Fig. 5. Plan of boiler room above boilers and also extension to turbine room.

Item 1 (Cont'd) Page 6 FOSTER WHEELER CORPORATION

SUMMARY PERFORMANCE SHEET — STEAM GENERATOR

Name: Gibbs & Hill, Inc. Proposal Number 43843
Location: For - Virginia Railway Co. Date Oct. 25, 1946
Number of Units: 1 Design Pressure 400 Dwg. No. FD-400-46

		50	100	200
		300.6	308.2	332.8
		300	300	300
		780	815	845
		227	227	227
		80	80	80
		435	452	508
		1320	1680	1930
		685	870	780
		298	318	407
		11.9	14.2	14.2
		11.5	13.8	13.8
		28	29	29
		60	33	33
		47.8	133	278
		60.8	150.2	304.8
		36.7	113.8	246.2
		.10	.10	.10
		.56	.40	1.74
		-	.02	.08
		.16	.60	1.50
		-	.02	.10
		.70	1.14	3.53
		.55	.86	2.25
		.01	.21	1.10
		0.80	2.02	2.24
		1.05	2.86	5.58
		1.9	6.4	18.1
		13200	43700	91000
		2420	7930	16850
		2270	7490	15800
		6.16	5.86	7.94
		3.76	3.78	3.94
		.15	.14	.20
		.08	.46	.75
		4.80	1.16	.58
		1.50	1.80	1.80
		16.94	12.70	14.91
		83.06	87.30	85.09

Above Performance Based on 1000 ft. Elevation

* Before dilution in Ljungstrom Air Heater.
** Including leakage in Ljungstrom Air Heater.

Note: The above Performance does not include any [illegible] blowdown.

Burners

Fuel Bituminous Coal

Page

County

State West Virginia

Fuel Bituminous Coal

Proximate Analysis: As Fired 2.16 5.00 77.30 1.80 1.47 8.79

Proposal No. 43843 Revised Jan. 24, 19[illegible]

Fig. 6. Summary sheet of test made on the 200,000 lb per hr boiler

ture is blown into cyclones from the bottom of which the screw conveyors deliver the powdered coal to the bunkers. The pulverized coal feeders can be seen directly below the pulverized coal bunkers. As previously mentioned, there are four feeders and each feeder serves two burners.

Draft System

The original Springfield boilers operated on natural draft. Under the reduced capacity at which the boilers were operated during the depression period fly ash had never been a problem at the Narrows Plant. With the subsequent pick-up in business and the consequent increase in load, however, the carry-over of cinders and fly ash became objectionable and the Railway was called upon to do something about it. After a thorough study by the consultants, Gibbs & Hill, mechanical dust collectors were installed in the latter part of 1948. These are Western Precipitation Corporation units. American Blower Co. Sirocco induced draft fans were also installed at the same time. The induced draft fans of Springfield boilers Nos. 1 and 3 discharge into No. 1 stack while Springfield boiler No. 4 and the new Foster Wheeler boiler (No. 6) discharge gases into No. 2 stack. A dual collector, of course, was also installed on the new boiler.

Problems Involved in Breeching Alterations

The installation of the new dust collector and draft fans imposed an engineering problem of considerable difficulty, one without much precedent. To provide space for the new dust collectors and the induced draft fans, it was necessary to remove the existing breeching. With the new equipment in this space, it was no longer possible to discharge boiler gases into the stacks through the bottom. The only solution was to go above the roof and cut new openings in the sides of each stack. To cut these openings 100 ft above the ground without interrupting the operation of the plant and without endangering the stability of the structure required most careful design and planning.

The 25-ft diameter reinforced concrete walls are some three feet thick at the base. Three of the openings for the flue connections were to be 6 ft wide by 11 ft high. The 4th opening for the new Foster Wheeler unit was to be 7 ft, 2 in. wide by 11 ft, 2 in. high. These are sizable openings and the problem was to cut them without weakening the stacks during operation and to restore the original strength after the openings had been cut. Steel frames of sufficient structural strength were designed to take care of the second part of the problem but it was also necessary to avoid too severe weakening of the structure during the installation.

After much study and investigation it was decided to carry out each operation in two steps, that is, cut half the opening, install half the steel frame with a temporary center post, then cut the other half and install the remainder of the frame similarly reinforced. Each half frame was completely assembled and welded in advance and when placed in position, was welded to the exposed ends of the reinforcing steel. The space between the frame and the original concrete was then gunited with a rich concrete mixture. In addition to the steel frames, two steel bands four inches wide were installed to restore circumferential reinforcing.

The job was carried on slowly. Tension was particularly high between the time a half opening was cut and its frame securely concreted in place. A high wind at this time would have added to the tension. All work had to be done from the outside, for the existing boilers could not be shut down. Before *breaking through*, a temporary bulkhead of canvas had to be placed inside the stack to protect the workmen from fumes and to maintain draft. It was a source of satisfaction to everyone and particularly the engineers responsible for the work that the job went through without mishap or delay.

The Turbine Room

As already mentioned, the new turbine room extension, in addition to housing the new 10,000-kw generating unit, also provides space for the deaerating feedwater heater, storage tank and the boiler feed pumps. The location of this equipment is shown in Fig. 5.

The deaerating heater installation, supplied by the Elliott Company, consists of a 1,000,000 lb per hr heater and vent condenser, a 2700 cu ft storage tank together with control valves and pressure switches.

Three boiler feed pumps are provided for the plant boiler, all furnished by the Byron-Jackson Co. These are centrifugal units each having a capacity of 1050 gpm when operating under a total dynamic head of 1031.5 ft at a speed of 3550 rpm. Two of the pumps are driven by Elliott 350 hp, 25 cycle motors through Farrel-Birmingham reduction gears, and the third by an Elliott steam turbine operating at 3550 rpm.

The new electric generating unit is

(Continued on page 124)

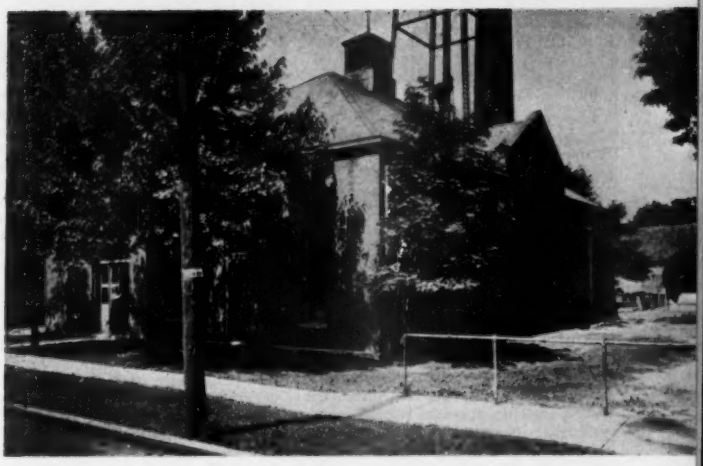


Fig. 1. Around, and over, this original building was built Rensselaer's modern brick power plant. When enclosed, this old station that had seen forty years of service was removed

DIESELS *Power* 52-Yr Old Municipal Utility

IN THE EARLY YEARS of the city-owned power plant at Rensselaer, Indiana, two services were supplied, electricity and heat. Power was generated by steam engines, the exhaust from which was used to heat two nearby grade schools and the high school. With the demand for heat during the heating season about balancing the amount of exhaust steam that came from power generation, this seemed to be an ideal arrangement at the time. In later years, however, the growth in electric service had reached a point where the demand for electricity far surpassed the heating demands and thus eventually led to abandoning the heating service.

The city started supplying municipal service in 1898 with the purchase of a privately owned plant for a price of $9000.00. The original plant had been built in 1888 and consisted of a small return tubular boiler and a 60 hp slide valve engine belted to a single phase, 133 cycle, 1100 generator. In the years which followed, additional and larger engines and boilers were installed and the electrical system changed to 3 phase, 60 cycle.

By 1921 it became evident that the 20 by 42 inch Corliss engine with its 200 kw generator and a 15 by 20 inch high-speed engine of 100 kw capacity were insufficient for the city's growing demand for electric service. Operating costs, too, had risen to a point where something had to be done to provide lower cost generation. A consulting engineer was engaged and after several projects were considered, it was decided to abandon steam power and install Diesel units for all future expansion. It was not until 1924 that all details had been worked out and in that year the first Nordberg Diesel was installed, this being a five cylinder, 15 by 20 in., two-cycle air injection crosshead constructed engire of 550 hp with a 375 kw generator. The engine was installed in the existing building in space formerly occupied by the pumps of the city water system and these had to be removed to a newly constructed building before installation work could be started on the engine. No change was made on the building. The air suction line of the engine was carried to a cupola on the roof, which effectively silenced the suction and the exhaust carried to the brick smoke stack, which served as a silencer.

Since steam still had to be supplied to the three schools and a steam engine kept available for stand-by service, the steam plant could not be abandoned at this time. In order to keep one boiler ready if needed, a waste heat generator was placed in the exhaust line of the Diesel engine, which with a banked fire, maintained pressure in one boiler so that the steam engine could be placed on the line quickly, if needed.

The plant continued to operate under this condition until 1928, when the load had reached a point where more generating capacity had to be added. In that year, another Nordberg Diesel was installed. This was also of the air injection crosshead design, of 875 hp with 600 kw generator and was located in the space that had been occupied by the Corliss engine. Steam was abandoned with the installation of the second Diesel. A comparison of steam and Diesel operation shows the savings in fuel that were accomplished with the more efficient type of power unit. The last year that the steam engines were used, the cost of coal alone to generate 900,000 kwh was $24,000. The following year, the Diesel engine required fuel oil to the amount of $8186.05 to produce 1,023,000 kwh. The comparative fuel cost per kwh was 2.66 and 0.8 cents respectively.

A reduction in rates was put in effect as soon as each Diesel was added. This resulted in a rapid growth in load, particularly from electric ranges since Rensselaer had no gas system. From this and other sources, the load continued to increase and by 1932, a third Nordberg Diesel had to be installed. This was also an air injection engine of 1425 hp with 1000 kw generator having about the combined capacity as the first two units. The old power house could not accommodate a third unit and it was decided to replace it with a modern building that would meet the city's needs for some years but capable of being extended if necessary. Since the original plant was centrally located, it was decided to build on the same site. This was not an easy task since it meant building over and around the old building and at the same

time maintaining service with the existing equipment. When enclosed, the old building that had seen almost forty years of service was removed.

The conditions which prevailed at Rensselaer were typical of most municipal plants. Increased use of electric service kept pace with added generating capacity. By 1940, the load had again grown to the point where a fourth unit was needed. In that year a six cylinder mechanical injection 1500 hp engine was added, which brought the plant capacity up to 4350 hp.

With this engine in operation it was thought that the plant could take care of the city's needs for some years to come, but within eight years, consideration had to be given to further expansion. The building would not accommodate another engine and it had become necessary to purchase adjacent land for this purpose. At the same time an order was placed for a fifth Nordberg engine, this unit having a capacity of 2800 hp. The engine went into operation in 1950 and gave the plant a total of 7150 hp, one of the larger municipally owned, Diesel engined power plants in Indiana.

This latest engine has seven cylinders of 21½ bore and 29 in. stroke, of mechanical injection, trunk piston design and operates at 225 rpm. It drives a 2400/4160 v, 3 phase, 60 cycle, 1980 kw General Electric generator with 25 kw General Electric V belt driven exciter. Since placed in service, this engine has carried the major portion of the load. Normally it is operated from 14 to 16 hr each day until the load drops to where it can be carried by one of the smaller units. In March, the engine operated 444 hr, generated 475,500 kwh on 36,440 gal of fuel oil or a production of 13 kwh per gallon with the engine carrying an average load of 54 per cent. The lube oil consumption for this period was 10 gal in the crankcase and 126 gal for cylinder lubrication for a total of 136 gal or at the rate of 9141 hp-hr per gal of lube oil. Comparing present day production of this new unit with that of the plant when Diesels were first installed, we find that in two months the new 2800 hp engine generates an amount about equal to the entire output in 1925.

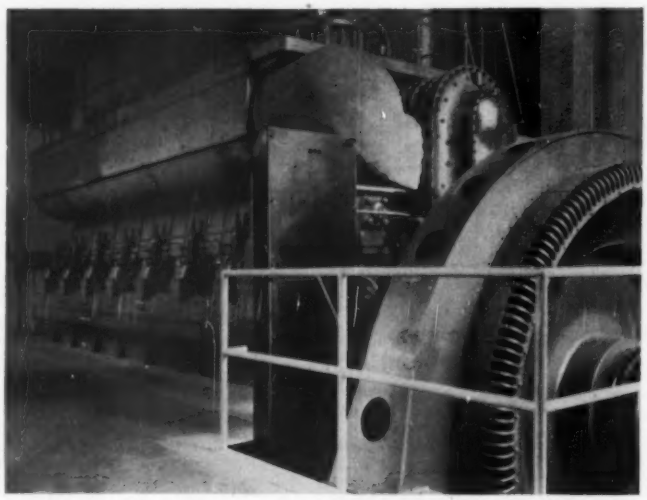


Fig. 2. (Above) The new 2800-hp Nordberg Diesel engine drives a 2400/4160 v, 3-phase, 60 cycle, 1980-kw General Electric generator

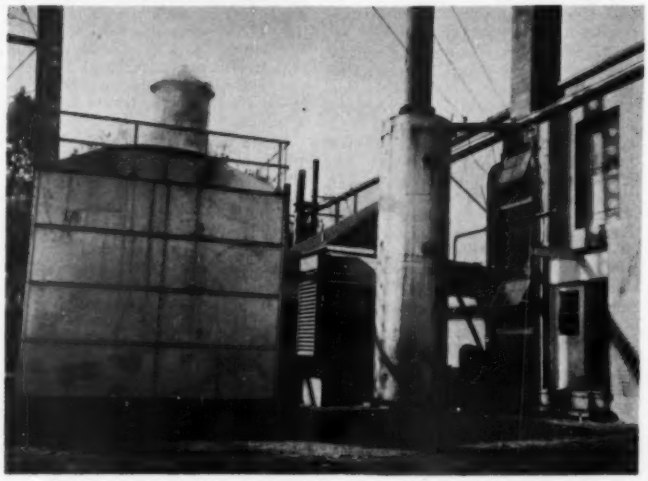


Fig. 3. (Right) Marley cooling tower, Burgess-Manning muffler and American continuous air filter located at rear of plant

Mounting costs have affected operations at Rensselaer in the same manner as other plants engaged in the generation of power. In 1940, 4,067,200 kwh were generated with a fuel cost of $18,914.50, while in 1949, the production had grown to 6,906,500 kwh, but the cost of fuel had risen to $74,470.29. The fuel cost per kwh had almost doubled. Operating labor had also shown a similar increase. This has increased from $4130.54 in 1940 to $8016.30 in 1949.

For Indiana cities in the 2500 to 10,000 population group, lighting rates at Rensselaer has long been amongst the lowest in the state. Residential consumers enjoyed the low rate of 3.6 cents for the first 50 kwh used per month and 1.8 cents for all over 50. In 1949, it was necessary to put a rate increase in effect to offset the inflationary costs of fuel and labor. The present rates are as follows:

RESIDENTIAL LIGHTING

First 50 kwh	5 cents
Next 50 kwh	3 cents
All over 100 kwh	2 cents

COMMERCIAL LIGHTING

First 100 kwh	5 cents
Next 200 kwh	4 cents
All over 300 kwh	3.5 cents

POWER

First 400 kwh	4 cents
Next 300 kwh	3 cents
Next 10,600 kwh	2¼ cents
All over 11,300 kwh	2 cents

While most municipal plants reach the peak load in early evening, the peak on the Rensselaer plant comes at the noon hour. This is accounted for by the extensive use of electric ranges. More than half of the residential customers use electricity for cooking since gas service is not available.

Provision is made for an adequate

supply of fuel in case of emergency. At the present time, fuel is deliverd to the plant by truck, three times a week, from the refinery at Whiting. In addition to truck delivery, fuel can also be received by rail. At a siding about six blocks from the plant is a 90,000 gal vertical tank with pump house and a small motor driven pump for unloading and transfer to truck. At the plant are two 26,000 gal above ground horizontal storage tanks with motor driven pump for unloading. From these tanks fuel is delivered to an elevated inside storage tank by a Viking pump driven by a 1-hp motor. From this tank all five engines receive their fuel which flows by gravity to the engine day tanks. The day tank for the 2800-hp engine is located outside the engine room wall in a storage room at one end of the new extension to the building. From the day tank, fuel flows by gravity to the engine driven fuel pump, then through duplex size 4R Nugent filters and then to the fuel header from which the injection pumps receive their supply.

Fig. 4. Honan-Crane oil purifier, day tank and Blackmer auxiliary fuel transfer pump set at engine room level as a precautionary measure against high water damage

In this storage room there is also a No. 35 Blackmer pump driven by a 1½-hp motor permitting transferring fuel direct from outside storage to the day tank should there be a failure of the normal method of fuel delivery.

Cooling Water System

In the early days of the Diesel plant, considerable difficulty was experienced due to the corrosive action of the water on the piping, and as a result, closed cooling water systems were installed for all engines with soft water used for both the cooling and jacket water circuits. A Zeolite water softener is used. For the four older engines, there are two atmospheric-type cooling towers of wood construction while the new 2800-hp engine has a forced air Marley tower of metal construction.

Raw soft water from the tower is circulated through a CP Ross lube oil cooler and then through a CP Ross heat exchanger by a 20-hp Allis Chalmers Electrifugal pump of 700-gpm capacity at 70 ft head and then back to the tower. The jacket water is circulated through the heat exchanger by a 15-hp Allis Chalmers Electrifugal pump of 700 gpm capacity at 70 ft head. The jacket water circuit has an overhead surge tank. Provision is also made that should there be a failure of the cooling system, raw city water may be used in an emergency for the jacket and oil cooling circuits.

Lubrication

Like other Nordberg Diesels of this type, the 2800-hp unit has two systems of lubrication. The pistons are lubricated by force-feed lubricators, one for each cylinder and these deliver oil to six points around the periphery near the upper end of the liners. Lubrication of the crankshaft journals, crankpins, piston pins, camshaft bearings, gears and other parts requiring lubrication and the cooling of the pistons are cared for by a circulating pressure system. Oil from the bearings and pistons drains into the sump, where a built-in pump circulates the oil through a duplex Nordberg strainer, the Ross lube oil cooler and then back through the engine for recirculation. A Model 2536AH Honan-Crane oil purifier operates continuously, taking oil from the sump and after purification, again returns the oil to the sump supply.

A Blackmer, Size 300, auxiliary lube oil pump driven by a 15-hp motor serves as stand-by for supplying lubrication before the engine is started and after it is shut down. A pressure switch starts the pump should the lube oil pressure drop below a predetermined point.

Scavenging Air Supply

Air for scavenging is brought to the engine by a gear driven blower mounted at the flywheel end and takes its suction through an American Air Filter Co., continuous self cleaning curtain type air filter having a capacity of 12,900 cfm.

A five panel electrically operated General Electric Switchboard is located adjacent to the operating side of the 2800-hp engine. This board has a tie-in panel to the main distributing board. A 60-cell Exide battery furnishes the energy for operating this board.

Fig. 5. Rensselaer's attractive red brick power house. The recent addition was made to the left side of the building to accommodate the new 2800-hp Diesel

Since the plant is located in a residential section within three blocks from the business district, nearby to a high school, two public schools, library and two churches, quiet operation is paramount and the noise has been so efficiently silenced that anyone passing the plant is scarcely aware that the engines are running. The 2800-hp engine has Burgess-Manning exhaust and intake snubbers.

Mounted on the engine gage board is a Viking alarm for low pressure and high temperature of jacket water and lube oil. Also on this board is an Alnor Type BZ (30) pyrometer for determining exhaust temperatures.

Rensselaer can be proud of the record of its municipal power plant which is a valuable asset to the city. It has grown from obsolete, inadequate steam equipment to efficient Diesel power, housed in a modern building with ample capacity to care for the city's needs for electric service. Never has the city had a failure of power supply. The successful record of the plant in no small measure is due to its supervision and experienced operating personnel. Louis C. Ramp, Superintendent of both the electric and water systems, has long been associated with the plant and it was under his supervision that the last two Diesel installations were made. Mr. Ramp designed the installation of his newest Diesel generating unit to be as independent of the rest of the power plant as is economically possible. Also the new unit has been installed at a higher level and without basement. These later improvements were the result of Mr. Ramp's experience with floods and deterioration of piping by cooling waters.

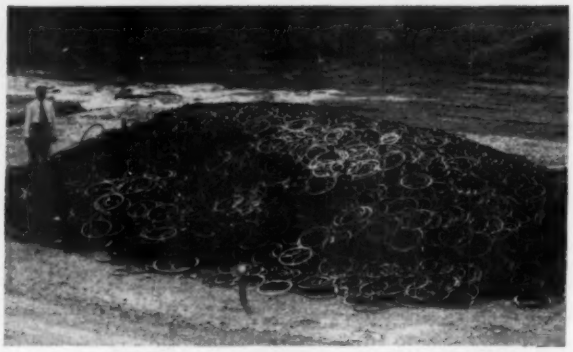
* * *

NEW YORK STATE Society of Professional Engineers will meet at their Silver Anniversary Convention at the Hotel Statler on May 10, 11, and 12. All functions at the convention will be held in the Sky Top and Penn Top Rooms of the hotel.

A symposium keynoting "The Engineer in Industry" will be held on Thursday, May 10. On Friday, May 11, a forum will be conducted on "The Engineering College and Industry."

Power Engineering

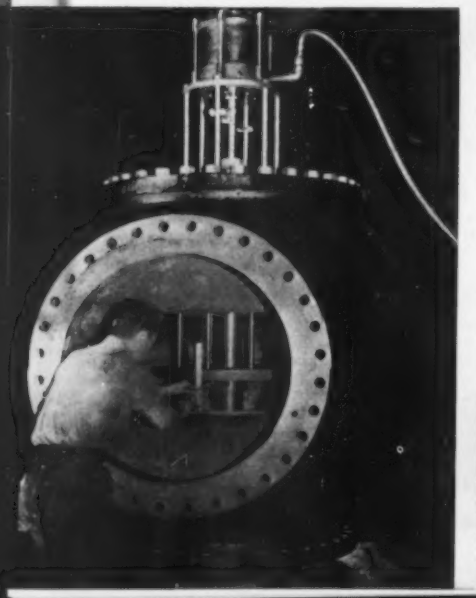
Here's a later and much better picture of Bailey Meter Co's new Mini-Line console than was available for our January issue, page 65. The 3-ft wide console carries all automatic and manual controls, indicators and alarms for a single boiler



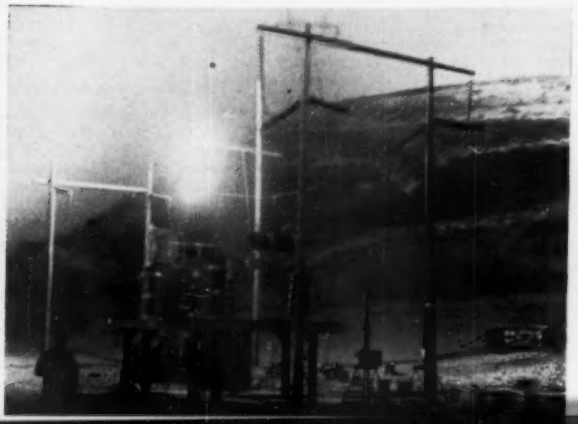
Here's $317,000-worth of zeros, each equipped with its own rim. Double Seal Ring Co. recently declared obsolete and scrapped these 75,000 rings of all sizes and types, shown in this 42-ton pile just before they were sent to the foundry for use as scrap iron

Right—At right of this photo is shown an unusual new coal unloading tower built by Dravo at the Frank R. Phillips power station of Duquesne Light Co. This unloader, operating on a-c, features rope reeving arrangement that eliminates clutches and brakes, equalizes load on bucket ropes at all times and simplifies operators' duties. Fully described by E. M. Hays in paper before 1950 Annual ASME meeting

Below—One of several double-ported control valves for a tonnage oxygen plant, built by Kieley & Mueller, believed largest ever built. Valves have 36-in. pipe connnections; designed to open and close fully in 1 sec. Valves installed on sides, so plug guides have linear-type roller bearings



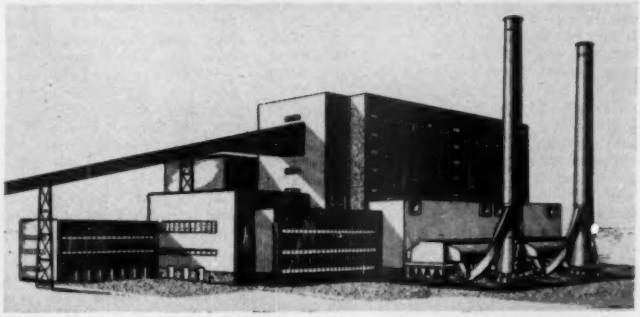
Below—New record was set in recent short-circuit current tests at Grand Coulee by GE and Bureau of Reclamation. Twelve of the 14 Grand Coulee generators, plus all available capacity of Northwest Power Pool threw 12,000,000 kva symmetrical 3-phase power into a single-pole unit of one of the thirteen 10,000,000-kva 230-kv oil circuit breakers at Grand Coulee



NEWS REEL

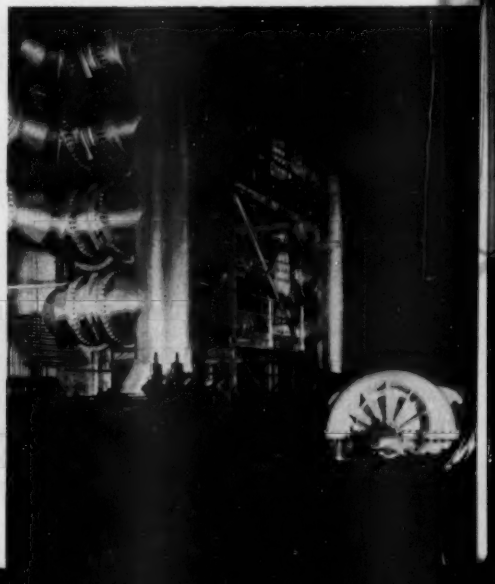
The small figure is the photographer. He is Harold E. Foss, Bureau of Reclamation photographer stationed at Ephrata. For the second year in a row he has been honored by having one of his pictures included in the *U. S. Camera Annual*, bible of professional photographers. The 1951 annual includes, as a two-page spread, this shot taken inside the 25-ft diameter Dry Coulee Siphon No. 1 on the West Canal of the Columbia Basin project. The picture is a self-portrait. No—he didn't use a wire. It was simpler than that. Foss set the camera on a tripod, opened the shutter and than ran forward, weaving from side to side, until he reached a position about 100 ft from the camera. He stood still for a short time, then zigzagged back to close the shutter, completing a five minute exposure. He used a 4-by-5 Speed Graphic camera, with a wide-angle lens to heighten the effect of the shot. The camera was set about 300 ft from the opening of the huge steel reinforced concrete pipe, with natural lighting, which came from the opening of the siphon at the rear of the camera

Above—It's done with mirrors—micro-wave communication, that is, between a generating plant of Pennsylvania Electric Co. and a substation 12 miles away. No direct line of sight, so micro-waves are bounced off this aluminum reflector visible from both points—handles 7 voice conversations at once. Westinghouse photo



Above—Detroit Edison's projected new St. Clair power plant on which construction has already begun, will look approximately like this from the river. This artist's conception is still tentative. Initial installation to consist of two 156,000-kw units—one on order from GE, other from Allis-Chalmers. Steam conditions 1800 psi, 1000 F, reheat to 1000 F; Photo courtesy *Coal to Kilowatts* and *The Synchroscope*

Right—Two new DeLaval, 100,000 cfm blast furnace turboblowers and intricate piping system recently installed by Dravo at Jones & Laughlin Steel Corp.'s Eliza furnace. Turbines take 410-psi, 700-F steam



Below—Two generators at New England Hospital for Women and Children, Roxbury, Mass., celebrate their 50th anniversary. One a mutipolar, 60-kw, 115/120-v, 500-amp, 280-rpm unit, other a 30-kw, 115/120-v, 250-amp, 305-rpm machine, both built by GE at Schenectady. Only maintenance work ever done was turning down the 60-kw unit commutator 10 years ago

Sweden Has World's Longest,

The 380,000 v line from Harspranget, north of the Arctic Circle, to Hallsberg in Central Sweden is 600 miles long. At Hallsberg the power is stepped down to 200,000 volts! This line is only one of many extremely interesting electrical projects developing in Sweden at the present time. Another project of unusual interest is the construction of a 55 mile long 100,000-v d-c under-sea cable beween the mainland and the island of Gotland. This cable will have only one conductor, the return being through the sea water

THE PRODUCTION of electric energy in Sweden has been expanded rapidly during the last 25 yr, and especially during the last decade. In 1950, 18,300 million kwh were produced, as compared with 16,140 millions in 1949, 8,600 millions in 1940, and 3,700 millions in 1925. The harnessing of water power is closely associated with the country's industrial growth, and today it is being carried still further to meet the ever-increasing demand for electric power. In two years production is expected to reach 21,000 million kwh. Water power resources which are economically available are estimated at a total of 40,000 million kwh, and it seems likely that they will have been exploited to the full in about 20 yr.

Since Sweden lacks coal and oil it is only natural that the country should turn to its rivers and lakes for its energy needs, and thus it has become, in proportion to population, one of the world's leading producers of hydroelectric power. Per capita, the Swedish production of electricity is approximately the same as that of the United States, but while only about 30 per cent of the American output is based on water power, Sweden covers 96-97 per cent of her requirements by hydroelectric developments. Except for the island of Gotland, which lacks water power resources and so far has been supplied entirely by steam power stations, and some industrial steam power generation, steam power plants have been built mainly to meet emergencies. The importance of Sweden being able to satisfy her own energy needs to the greatest possible extent became especially evident during the Second World War, when coal imports were drastically reduced and shipments from England were completely cut off. Thanks to her "white coal," Sweden was able to keep her industries operating at full capacity and her railways running.

Longest Overhead Power Line in World, and First for 380,000 Volts

From one point of view, the Swedish power situation is somewhat paradoxical. Most of the waterfalls are located in the northern part of the country with its very sparse population, while the heaviest consumption takes place in the South. To bridge this gap six 200,000-v lines have been constructed, extending from Porjus in the far North. From Porjus there are also lines going out to Norwegian power stations at Narvik, and in the South the Swedish system is connected by submarine cables with Danish power plants.

The constantly growing demand for power, however, has given rise to a need for a transmission system with a higher capacity than the 200,000-v lines. The State Power Board, which is building several large power stations in the North, in 1947 began construction of a line for alternating current at 300,000 v, the highest working voltage in the world. It was expected to be completed in March this year and covers a distance of 600 miles, from Harspranget on the Lule River, 22 miles north of the Arctic Circle, to Hallsberg in central Sweden. It is the longest overhead power line in the world. At Hallsberg, the power will be stepped down to 200,000 v and fed into the distribution network emanating from this station. A second line, extending over about 300 miles, is planned for completion in 1953, and the construction of a third line, from Hallsberg down to the country's southernmost province, has just been decided.

The new high-voltage transmission involves some unusual features, such as a double conductor line instead of the customary single, and the utilization of large series capacitors for reducing losses. The cost averages about $23,000 for each kilometer ($30,800 per mile) or 162 per cent of the cost of a single line for 200,000 v transmission, but the transmitted power of the high voltage line is more than three times that of the lower voltage.

Research on the possibility of using high voltage direct current for long-distance transmission also has led to important decisions. Alternat-

Fig. 1 Water power plant in the north of Sweden. This station is part of the Krangede System with a total capacity of 175,000 kw

Highest Voltage Power Line

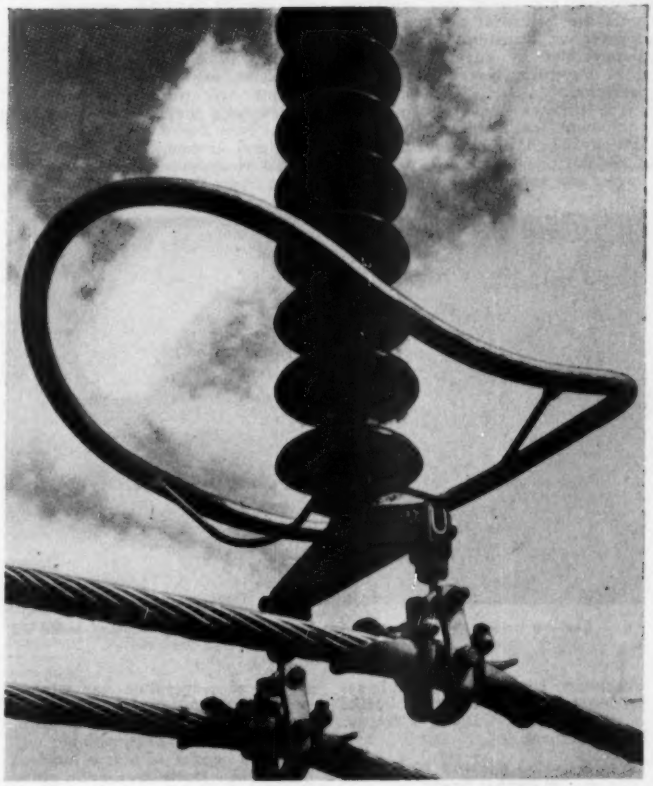


Fig. 2 Suspension insulator for the 380,000-v, double conductor line

ing current cannot be used in submarine cables to the island of Gotland, which still depends on steam generated power, but plans have been made for a high tension d-c system for the transmission of hydroelectric power to this island in the Baltic. The project involves laying an under-water cable for 100,000 v, 55 miles long, between the mainland and Gotland, and installing a station on each end converting 130,000 a-c to 100,000 volts d-c at the intake end and again to AC at the output end on the island. The cable will have only one conducting part, the return current being conducted through the sea water. Special tests have shown that this system will not harm fish or other sea life. The project, which was worked out under close cooperation between the State Power Board and the ASEA company, Sweden's leading manufacturer of electrical equipment, is the first of its kind in the world. The transmission is expected to be ready for testing in 1954, but it may take two or three more years before regular operations can start.

Expansion Directed by Both Public and Private Enterprise

The continued expansion of Sweden's water power industry is based on both public and private enterprise. In the North a number of power stations are under construction or being planned, and the largest is the Harspranget plant, which is being constructed by the State Power Board. The Harspranget Falls, on Lule River, is the most important source of water power in Sweden, and the new station will also be the largest in the country, with a capacity of 300,000 kw. and a normal output of 1800 million kwh a year. The station will be equipped with three generating sets, each with a capacity of 100,000 kw, almost equaling the world's largest units in the Grand Coulee Dam. The first unit is expected to be ready this spring, and all three units are scheduled to be in operation next year. A fourth unit may be installed later. Like many of Sweden's power stations, the Harspranget plant is built in the rock, an arrangement which provides greater resistance to air attacks and the advantage of an even temperature throughout the year. The powerhouse at Harspranget has been blasted out of the rock 225 ft underground. After passing through the turbines, the water will be discharged through a tunnel, one and three-quarter miles long, and the rock excavated from the tunnel is sufficient for nearly all the stone filling required for building the dam.

The Harspranget power plant is an enormous project according to Swedish standards, costing more than 100 million kroner. Still higher costs, however, are involved in the building of the transmission lines, and for the complete project, the expenditure is calculated at about 230 millions.

Private Companies Account For More Than Half of Power Production

Power supply in Sweden is administered by the Government through an independent business concern, the State Power Board, by private companies, and by municipal authorities. The three groups cooperate to a great extent. The Government is responsible for about 40 per cent of total production and distributes power over an extensive network, both to the railways and industrial concerns and to municipal distributing associations. About 5 per cent of the country's output is in the hands of municipal authorities, while private companies provide the remaining 55 per cent.

Practically all power stations in the country are coordinated, and an exchange of power takes place on a large scale in accordance with schedules drawn up each week. Thus shortage of electricity in one area can be met by drawing power from other districts having an excess of water, emergencies can be tackled promptly, and the joint utilization

of the power available also contributes towards rational economizing with water and reduced need for steam generating capacity. The joint operation is managed by a special agency, the Central Operating Management. In its office the general strategy of water power utilization is outlined, and from its operating room the failure of a high voltage breaker or transformer is immediately met by engaging parallel lines or putting reserve stations in operation.

The turbines, generators and other equipment for the Swedish power stations have been manufactured almost entirely by Swedish privately owned and managed firms, the most important one being the above-mentioned ASEA company. Head of the State Power Board is 38-year old Ake Rusck.

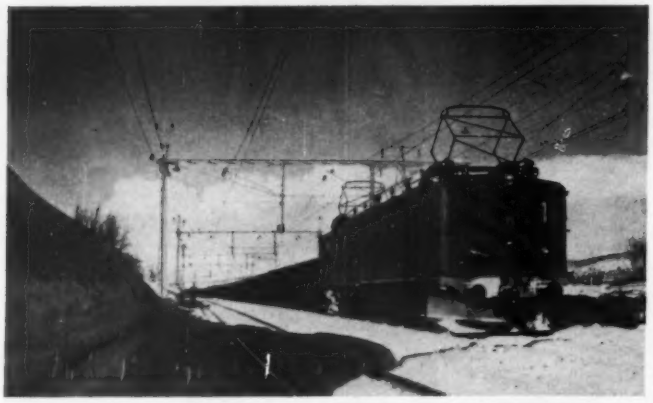


Fig. 3 Iron ore train in the north of Sweden. All railroad lines with heavy traffic are electrified

Large Industries Consume 70 per cent of Electric Power

Industry is the largest consumer of electric power, accounting for about 70 per cent of total consumption. The railroads take 10 per cent, while 15 per cent is used by small industries and for household purposes, illumination, etc., in cities and other urban communities and 5 per cent is distributed in the rural districts.

The largest industrial users of electricity are the chemical industry, the ironworks and the pulp and woodworking industries, which together answer for about three-fourths of industrial consumption. As for the railroads, about 40 per cent of the total track mileage has been electrified, but since this includes all lines with heavy traffic, electricity is used for transportation up to a little more than 80 per cent of the total volume.

In the homes, electricity is being used to an increasing extent. Electric stoves, refrigerators, washing machines, toasters and other household appliances have found their way into homes. About 93 per cent of the homes in the rural districts are supplied with electricity, and the rural electrification will probably be completed in a few years, the Government offering considerable financial support for this purpose. In many rural districts power distribution is managed by cooperative associations, in which the consumers themselves are members. The associations are run by committees elected from the members, and the State Power Board offers them technical and economic advice free of charge. Neighboring associations frequently pool their skilled labor. This system of cooperation has worked very satisfactorily, especially when the associations have a limited number of subscribers. A suitable unit seems to consist of a few hundred households. If the association grows beyond this size, it is often difficult to find persons who can devote enough time and energy to the task.

The rural population is becoming increasingly aware of the advantages of more extensive electrification. There are still some districts where electricity is used only for lighting, but it is being utilized more and more for the farm work and in the kitchen. The shortage of labor also has made the farmer rely on machinery to an increasing extent, and improved standards of living in the country automatically result in higher consumption of electricity.

Relatively Low Tariffs Thanks to Reasonable Construction Costs

So far it has been possible to keep the building costs for the Swedish power stations at a low level. This is largely due to the fact that the plants are simple in design, and other factors of importance are the satisfactory rock foundations and the comparatively low dams. Power tariffs are low compared with rates in countries where power production is based chiefly on steam, but higher than those in countries more favored with water power than Sweden.

PLANS FOR UNIFYING ENGINEERING PROFESSION

(Editorial Comment)

INCREASED UNITY of the engineering profession has been the subject of countless bull-sessions among engineers for more years than we care to remember. Various sporadic attempts to do something about it have always been wrecked on one rock or another. But now the urgent and vital need for a unified professional organization, recognized by all engineers, has led to the formation of an exploratory group representing 16 national engineering societies to consider increased unity of the engineering profession. This group has a planning committee, which has developed four plans:

Plan A:—Expand the Engineers Joint Council to include other engineering societies and arrange joint membership in EJC and a professional society, such as ASME.

Plan B:—Identical with Plan A except it would permit individual membership in EJC.

Plan C:—Merge EJC and National Society of Professional Engineers.

Plan D:—Adopt National Society of Professional Engineers as the unity organization.

The plan is based on a number of adequate principles, including the following points:

1. The unity organization should be formed by modifying and developing a present organization or by integrating two or more present organizations rather than by establishing an entirely new organization.
2. The unity organization should, in the beginning, include a majority of the national engineering societies represented in the exploratory group.
3. Some method should be provided for membership of individuals in the unity organization.
4. The participating societies should appoint or elect directors to control the unity organization.
5. Activities of the unity organization should be determined by its governing body, in the constitution of the organization, by a broad statement of general purposes.

We have not received enough information on the details of the above plans to warrant an expression of opinion about them. To form such an opinion, however, a number of points must be considered.

The organization must be set up in such a way that it will attract the greatest participation and interest from all segments of the profession.

Plan A could be put into effect in minimum time and contemplates no changes in present societies. It presents an opportunity to show a united front almost immediately.

Plan B would involve heavier dues for separate EJC membership.

Plan C might involve cumbersome details.

Plan D would require no new organization but it might necessitate changes in membership requirements of NSPE to permit non-registered engineers to belong.

In any event, we need to use what we already have available, to best advantage, as quickly as possible.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

JOE DARNELL

As reported briefly in the February issue, our old friend and one-time colleague, Joseph R. Darnell died after a short illness on January 4. Joe's death came as a great shock to us because only a few weeks before he had been in our offices full of plans for writing a series of articles on the characteristics of fans, and he seemed well and in good spirits. We had lunch together. Then, suddenly, shortly after the first of the year Mrs. Darnell wrote us of his passing. We shall miss him, not only as a friend but as a consultant on matters pertaining to combustion and fan design and operation, for he knew about these things as few others did. For a few years, back in 1925 and 1926, Joe had been one of us as Associate Editor of ***Power Plant Engineering***, and ever since, though not directly connected with our organization, he had been a sort of Editor Without Portfolio, one to whom we could always refer difficult combustion problems.

His thorough early training under Henry Kreisenger in combustion engineering at the U. S. Bureau of Mines was reflected in his voluminous writings through the years. He was, perhaps, our most constant contributor, his comments on questions in the Questions & Answers Department were always interesting, and sometimes quite pointed. Joe was always ready to argue a fine technical point; he was direct in his approach, and his logic usually unassailable.

Joseph R. Darnell was born in Richmond, Ind., on Nov. 16, 1892. After graduation from Earlham College, Richmond, Ind., Joe became Assistant in the Fuels Section at the U. S. Bureau of Mines in Pittsburgh. From 1920 to 1924 he was Combustion Engineer for Sinclair Refining Co., and from 1924 to 1925 Engineer of Field Tests for Riley Stoker Corp. From 1925 to 1926, as already mentioned, Joe was Associate Editor of ***Power Plant Engineering***. In 1927 he became Assistant Manager of the Mechanical Draft and Economizer Department of B. F. Sturtevant Co., and continued as sales engineer until 1932. From 1933 to 1939 he was Consulting Engineer for Jenkins Petroleum Co., and in 1940 became Mechanical Engineer in the legal department of the Universal Oil Products Co. Early in the war years he once more associated himself with the Sturtevant Co. as District Manager of the Southwest District in Dallas, Texas.

During the last five years he had been in private consulting practice, first in Dallas and then in Milwaukee, Wisc.

AWK

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Glorious Retirement

Recent letters from the former chief engineer of Pennsylvania Sugar indicate that his alleged retirement in 1945 was merely a cover to further his own admirable interests. He is busier than ever and just as spry, judging by his globe-trotting activity

By A. W. KRAMER

IN THE May 1945 issue of this section of POWER ENGINEERING (then still called *Power Plant Engineering*) there appeared a short article entitled, "A Good Engineer Steps Down." This was a sincere testimonial to our old friend Dan Gutleben, chief engineer of the Pennsylvania Sugar Co. upon the occasion of his retirement after 24 years of 7 days a week on the job. In all those twenty-four, 365-day years of service he had only 5 days of sick leave.

Those of you who have read *Power Plant Engineering* for many years need no introduction to Dan Gutleben. His outstanding accomplishments as an engineer, his rare gift of understanding human nature, the whimsical philosophical quality of his writings gave him a unique privilege as a contributor, direct or indirect, to these columns over a period of many years. The fact that he was on the job 365 days a year need evoke little pity; he worked early and late, not because he drove himself but because he loved his job.

As we pointed out in the article announcing his retirement from active service with Pennsylvania Sugar, retirement for Dan Gutleben did not mean that he was going to loaf—not by any stretch of the imagination, it didn't. More than anything else, it would give him an opportunity to persue more effectively the writing of the Sugar History which had engaged his extracurricular activities for many years.

Well, we were not wrong in our predictions. Dan Gutleben has kept quite busy since he left his old drafting board in the engineering department at the Philadelphia Refinery. In his self-appointed task of collecting sugar lore, during the last five years he has traveled over a considerable part of the earth's surface —from England to Hawaii—visiting sugar mills, plantations, refineries, interviewing thousands of people. As the "old timers" pass on, he visits their families and arranges for the disposition of books and papers relating to the sugar industry. This involves a great deal of time and effort, much correspondence. Quoting from a recent letter, "Writing history and biography requires a whole lot of letter writing and checking. Getting dope by asking people to search the old bean for past events is less than 10 per cent effective—for every 100 letters I write, I get less than 10 answers. . . . Another activity that is keeping me on my toes is the collection of old books on sugar for distribution among the colleges where they may be useful. I write to old, superannuated sugar craftsmen or their widows and grandsons for the old man's books and then I insert a little biography of him and send his books to some college library in states where sugar production is practiced."

For many years, long before he retired, it has been Dan's custom at the end of the year—usually around Christmas time—to send out to his many friends in the sugar industry what he chooses to call "The Sugar Tramp." This is a report of his activities in the industry during the year. Written in his inimitable style, in third person by the *Chronicler* as he calls himself, this contains all sorts of information about the people, and their work, in the sugar industry. It is issued in planograph form, made directly from typewritten sheets, printed on both sides of the paper. Since leaving Pennsylvania Sugar in 1945, this annual report has grown tremendously. This year, it come to us 106 pages long, single spaced, Elite typewriting, a formidable looking document until one starts to read it. Then, you can't let it go—even if you are not active in the sugar industry. This year, it is called the Hawaiian Issue since it is given over mostly to a comprehensive and detailed description of the sugar industry in the Hawaiian Islands. Last year, the Chronicler and his wife traveled almost the entire length of the American Sugar belt which

Dan Gutleben and Mrs. Gutleben in the family car in which they travel the American Cane Sugar Belt

stretches 6000 miles from Puerto Rico to the Hawaiian Islands. Starting at Savannah, in the family motor car they visited plants, plantations, and people, collecting data and gossip for later incorporation into the Sugar Tramp. "Assuming the good ship Lurline and her groove through Mare Nostrum to be American Territory" Dan points out, "a traveler does not need to depart from America during the entire journey." The family car can even be taken along, says Dan, "but the *craftsmen* in Honolulu would be displeased with the implication of lack of hospitality."

Dan Gutleben has always been a great protagonist of technical magazines and editors of such publications were always welcome at his office. One always entered his office with a free and easy feeling. We knew that if we wanted data or information that he had, or could get, he would give it to us without strings attached and without requiring official approval. And there was always the LOG, that astonishing compilation of technical information, drawings and photographs recording every minute detail of the design, construction, and operation of that great refinery and power plant in the neighborhood of Shackamaxon and the Deleware River in Philadelphia. The LOG was always open to us. "I left about 40 volumes of the LOG" writes Dan in his recent letter, "records on the behavior of the men and machines.

"I still get a big deskful of craft journals" he writes, "but my eyes cannot cover them all. Besides I can't find time to read the *bread and butter* information without detracting from the main goal of collecting sugar history which the boys are importuning me to speed up.

"And so, he continues, "I am divesting myself of many of the things that have always fascinated me, so as to concentrate on the main subject. I've subscribed to *Engineering News* (Record) for 51 years, *Mechanical Engineering* comes with the membership, and now, that like all the rest goes to waste, except that my nephew picks them up. So I am going to give all of these up except the sugar journals of which I get 4 or 5.

"As to POWER ENGINEERING, it seems to me I haven't sent a check for a helluva long time. When you see the subscription clerk please tell him to send me a bill and then set me down as a past subscriber unable to extract further use out of that fine tool by the aid of which I was able to attain success and some slight repute in the design of our steam plant. We got for a million what cost our neighbor a million and a half, and we beat his production cost by 2 cents per M lb of evaporation. He claimed a couple of points of superior efficiency but we could burn the cheap coal which his furnaces could not stomach. It is amazing to contemplate that the pressure of 400 lb which is now only low pressure vapor, was a right respectable thing in 1930. I believe our old refinery produced more sugar in 1950 than any other eastern plant. The boys are doing a good job. The only thing that is now done differently, under the New Deal, is the change of hours. There are no more 12-hour days, and the week is no longer 7 days long.

"The old days of every man using his own head and his conscience has been replaced by a new order and they are not only maintaining the plant in mighty fine shape but producing more sugar than we did. The only difference is the new deal whereunder the work formerly done by one is spread to 2 or 3. It gives every man a lot of time to loaf and the consumers are pleased to pay the bill. The boys like their jobs and perform with enthusiasm but they like them only 40 hours a week against the good old 80 or more of 1920.

"Well, getting back to POWER ENGINEERING," said Dan, "I always liked POWER ENGINEERING and if the old scrap book (The LOG) is still at Shackamaxon Street you could find of couple of inches (thick) of excerpts of plant descriptions. I recall you had a graph once giving the water rate of engines and turbines for various initial and exhaust steam pressures. Bill Hoodless and I spent a Sunday forenoon working with this thing. When he saw how increasing the initial pressure reduced the exhaust he grew greatly interested in the proposed 400 lb steam plant. The next week he wanted to know how much the plant would cost, and not long after that we got started on the job.

"If the boys would select a good technical magazine when they leave college and read it carefully they would surprise themselves by the accumulation of information they absorb after a few years. It becomes amalgamated with their experience.

"Even now, I always spend an evening with it (POWER ENGINEERING) and then send it to my nephew who is in the atomic research outfit at U. of Cal. He makes excerpts for his scrap book. In the five years since I left Phila, I observe by your plant descriptions that some mighty big changes have taken place. It sends a chill up my backbone!"

Here, then, is one man to whom retirement brought anything but boredom. Of course, the term retirement in this case or in any other similar case is a complete misnomer. Men like Dan Gutleben never retire. Their enthusiasm for their work drives them on, regardless of their status in the economic scheme; they heed neither time clocks, or calendars. Five years ago Dan Gutleben was perfectly willing to relinquish his long-held job as chief engineer to some younger man but he knew very well his work was not done. As he says, "there are many men who satisfy the needs (of the industry) along mechanical lines but writing history is not a bread-and-butter job, and by common consent the craftsmen have assigned the job to me. I'll need 10 years to complete it." Let us hope that Father Time grants him at least those ten years.

Fuel Oil Complaints and Troubles*

This is the 13th and final installment of Mr. Schmidt's series on Fuel Oil Characteristics. In it he discusses various types of fuel oil complaints and troubles, all of which should interest the user of fuel under power boilers

By PAUL F. SCHMIDT
Allied Oil Company, Inc., Cleveland, Ohio.

IN THE USE and combustion of fuel oils, a variety of difficulties frequently arise, causing trouble. These troubles may be small, causing little inconvenience, while at times they are so serious as to cause complete shut-down of operations.

Many complaints are immediately charged to the oil, but a number of other factors can be the source of trouble, such as the mechanical operation of the burner, incorrect and inefficient operating procedure, and improper storage and handling of the oil. In some cases, the consumer or operator is responsible for the trouble, due to the use of an improper grade of oil purchased because it is cheap.

Many of the items listed are those that are caused by the fuel oil, but a number of others are also included. Many troubles are due to the same

* Readers who have followed Mr. Schmidt's articles on Fuel Oil Characteristics in these pages during the past year, and who would like to have the series in permanent form, will be interested to know that Mr. Schmidt has made arrangements with the Industrial Press to have the entire series published in book form some time in the near future.

source, which if corrected, can eliminate many operating difficulties.

Unable to Start

No oil—Sludge and water in lines—Too high viscosity—Too high flash—Blocked burner tip—Too low preheating temperature—No air—No atomizing pressure.

Flame Goes Out or Fluctuates

Water, sediment or sludge in the oil—Oil too viscous to maintain an even flow—Uneven air or oil pressure—Not enough oil due to loss of suction—Too high atomizing steam or air pressures.

Spitting, Sputtering, Sparkling

Water and sediment in oil—Too high viscosity—Too much primary air—Too much atomizing steam.

Poor Atomization and Combustion

High viscosity—Too low and too high preheating temperatures—Atomizing pressures too low—Oil pressure too low or too high—Insufficient primary air.

Loss of Heat

Oil too light—Low BTU value—Sediment and water in oil—Lack of air or too much air—Poor combustion—Too high preheating temperature.

Flash-Back

Too low flash, resulting in preignition—Water and sludge in oil—Too high oil pressure—Fluctuation of atomizing steam or air.

Carbonization of Burner Tip

High carbon oil—Too high viscosity—Poor atomization—Too high oil pressure—Excessive preheating temperature—Oil unstable—Insufficient air—Oil dribbling at shut-off burner.

Carbon Formation on Furnace Walls

Flame impingement—Oil too viscous or too light—Too high oil pressure—Cold furnace—Too high atomizing steam or air pressures.

Carbon in Preheater

Too high preheating temperature—Oil unstable—Sludge in oil—Asphaltic compounds in oil, which cokes or carbons on the hot surfaces in preheater.

Blocked Burner Tip

Sludge, lint in oil—Carbonization on tip.

Excessive Soot

High ash content of oil—Poor combustion—Heavy precipitated compounds in oil.

Excessive Oil Consumption

Oil too light—Low BTU oil—Oil pressures too high—Too much air—Poor combustion—Hole in burner tip too large.

Blocked Screens

Sludge, wax, lint in the oil—High viscosity oil—Cold oil—Heavy precipitated compounds in oil.

Plugged Lines

Sludge in oil—Congealed oil—Wax—High Viscosity—Foreign materials, such as, rags, tank scale or wood splinters.

Oil Not Pumpable

Oil too cold—High viscosity—Blocked lines and screens—Sludge—No suction in oil line.

Loss of Suction

Oil too heavy and cold—Leak in oil suction line—Slippage of oil pump—Suction line out of oil—Oil too hot.

Water

Water in oil as delivered—Condensation, natural and from high temperature heating—Leaking steam coils—Leaking tank or manhole.

Smoke

Not enough air—Poor atomization—Oil unstable—Too high viscosity—Too high oil pressure—Sediment and sludge—Cold furnace—Preignition—Flame impingement.

Corrosion

Certain types of ash—High sulphur and high salt content in the oil.

Discoloration of Ceramics

Some types of ash—High sulphur, sediment, iron in oil.

Bad Odor

Too high heating temperature—High sulphur, and certain types of sulphur compounds in oil—Contamination by various foreign materials.

Honey with a Good Scotch Flavor

Oscar, the Gas Works Owl, gives John good advice which he is prone to take until a combustion expert comes to the rescue

By JOHN RAVEN

ONE MORNING the Boss called me into his office, and I saw a little guy sitting there with a zipper-mouth, and three unsmiling females likewise with zipper-mouths, and I could tell right away I was in for something not good.

I was in no mood for trouble either, on account of having just come from a session with One-Sock Murphy, who is an ex-pugilist and the meanest fireman in the gas works, besides having recently started to raise an equally mean family of bees.

As usual I found him sitting on a bench reading something about bee culture, and paying no attention to his oil burners while the smoke was climbing up the sky like a mid-summer thunderhead.

"One-Sock," I yelled, feeling pretty sore at the way he was messing up the boiler, "put down that book and listen. You've got to get rid of those honey-bugs of yours, and I mean quick. Yesterday one bit Greaseball Charlie in the Gas House, and two of them put the hot foot on Pipe Nose Henry's nose. And already this morning Jingles Joe needs salve for one that slipped a stinger into his ear. Everybody's complaining, and what's worse, look at your burners, look at your stack. Smoke, smoke, smoke."

And then I added ominously:

"One-Sock, this has got to stop. And right now. Understand?"

One-Sock laid down his book, carefully marking the place with a plug of tobacco, and then he stood up in an endless unraveling of height and bulk like an elephant heaving to its hind legs. Next he stuck out his ex-pug jaw and from his 12 inch advantage of height addressed me in the following anti-peaceful words:

"John," he rumbled, "I ain't gettin' rid of no bees, see? And if you don't like my smoke, that's tough, because my bees do. They're a-makin' honey with a flavor of gas works smoke in it, like good Scotch whiskey, which I like, see? An' what's more, other people like it, an' I'm a-goin' to get rich, an' you better get goin' an' stop botherin' me, see?"

He knotted up the piledriver fist he calls Tom and thumped it significantly against the other piledriver fist he calls Jerry, and I backed off remembering that one sock from One-Sock had broken more than one opponent's jaw.

"An' also," he mused, like a bull meditating new deviltry, "tell them bums to stop sockin' my bees before I start sockin' them too. I don't like my pets gettin' socked, see? Now beat it. Git."

I got, reflecting sneeringly if there was one guy in the gas works who could prove Oscar the Owl is not as smart as he thinks he is, that guy is One-Sock Murphy. I pulled out of my pocket Oscar's latest lofty hen-

scratching of advice which read thusly:

njuneers would get along better by tryin 2 like peeple as well as they like machinery 4 instans u can like anybody if u look him in the i n say i like this guy n right away u bgin 2 c his good points its ezy n it works ur frend oscar the gas works oul hoo cs all n nos all

"Nuts!" I said right out loud. "Nobody could like One-Sock Murphy, no matter where you look at him."

I tore the note into little pieces and shuddered to think of my position when the Boss saw that mountain of smoke spreading steadily across the sky. Probably he would give me ten minutes to stop it or be fired, and if I tried to stop it, One-Sock Murphy would knock my head off. This was the situation when I came in sight of those zipper-mouthed faces in the Boss' office. They looked like a fancy collection of fatal accidents, waiting to happen to me, and with the Boss acting as trigger-man.

"John," began the Boss, his voice shaking with the emotion of an outraged benefactor, "After all these years, how could you do this to the gas works? Don't you realize that by pouring smoke and smells into the sky, you have forced these charming visitors from the Ladies Association for City Improvement, to consider taking out an injunction against us? After the way I have trusted you to keep our glorious skies clean and pure, what have you done? You have brought the gas works to the very verge, to the razor's edge, of being shut down by law."

He leaned back in his chair, his three chins quivering, and actually wiped the corner of one eye. He would do credit to Hollywood, the big bag of wind.

"But Boss," I said, starting to get mad at being made the goat, "How about the water gas house, and the coal gas house, and the stills? What they put into our glorious skies is—"

"Stop!" he bellowed. "I won't have excuses added to your failure. I ought to fire you on the spot! Now! However, the Ladies Association, to show their cooperative spirit, have brought along a combustion expert who will give instructions, personally, to every fireman in the place, on how to mix oil and, ah, how to adjust things. The injunction will be held in abeyance, to give us a chance to clean up. And now, you will please show this gentleman around the works, and help him to get started."

—Paying no attention to his burners

I looked at the little guy who bowed slightly, and I had a vision of One-Sock Murphy chasing him right out the gate, thereby bringing on a fast injunction that would raise a terrific public stink at best, and shut us down at worst. In either event my name was mud. I might as well quit now and get it over with.

"Boss," I actually began to say the fatal words, when I was interrupted by a bee that sat down on the Boss' left cheekbone and proceeded to ram a stinger into him with tremendous enthusiasm.

The Boss jumped up with a yell like he'd been hit by a General Sherman tank.

"Bees," he howled, slapping the poor thing to death. "They're swarming! Damn it John! Do something. They'll kill us."

"Boss," I said, "Open your eyes. They're not swarming. There's only one, and he's dead."

He knotted up his pile driver fists

He sat down mopping his cheekbone with a handkerchief, and had a quick peek at the three female accidents who were regarding him as though eager for the next act. He obliged them immediately. He stabbed at me across the desk with a big fat finger. His three chins shook.

"If you handled your department as you should," he bellowed, "we wouldn't have bees in the gas works. Supposing the brute had bitten one of our visitors? Suppose it had been a swarm? We might be lying on the floor now, dead. Don't you know bees can kill a man? John, you go at once and see that Murphy gets his bees out of the gas works right away, today. If I see a single bee around here tomorrow, you're fired. Is that clear?"

The little guy unzipped his gums for the first time.

"Bees in the gas works?" he said, standing up. "Interesting. Sir," speaking right at the Boss, "the presence of these bees may have real scientific value. If they are making honey, it may prove that gas works fumes actually are healthy. May I see these hives?"

Hold it, Murphy!

"John," ordered the Boss, "Show him the hives. Of course the gas works is healthy. Odorous perhaps, but healthy."

Before I could figure out what to say next, the little guy had me by the arm and we were heading for One-Sock Murphy, mayhem, assault, battery and sudden death.

"Mister," I said, "This One-Sock Murphy is a very quarrelsome character indeed. Can't we just study bees in the library or somewhere? Don't you think we are too young to die?"

"I've never yet seen a fireman I couldn't like, or couldn't handle," he said complacently. "Let's have a look."

I led him into the boiler house, concluding I might as well get it over with, especially since he obviously was crazy. The smoke was still pouring from the stack like an active volcano, One-Sock was still on the bench reading about bees.

When he saw me, One-Sock threw down his book and hollered: "Didn't I tell you to stay out of here, and quit botherin' me? I think I'll bust you wide open, see?"

One-Sock started toward me waving Tom and Jerry like a couple of pile-drivers on the loose. I put up my own fists and felt discouraged right away, seeing how puny they were compared to Tom and Jerry. And then unexpectedly the little guy stepped between us and he had an old scoop left over from the coal firing days, all poised above his right shoulder.

"Hold it, Murphy," he said. "I know all about you and your glass jaw. One more step and I'll lay you out for a week."

One-Sock pulled up, looking surprised.

"You know me, mister?"

"Sure. I've seen you fight many times. If you had a better jaw you'd have been a champ. Now I'm interested in your bees, and I want to taste your honey."

One-Sock grinned and somehow surprised me by looking almost human. The little guy threw his scoop into the corner and I dropped my fists. Then One-Sock scowled again.

"I got good honey," he said sullenly, "flavored with smoke, like Scotch whiskey. But John don't like my bees. He says I got to get rid of them."

"No wonder," said the little guy.

THE PRACTICAL ENGINEER AND ELECTRICIAN

"You've got the wrong kind. What you want are the gentle Italian bees, that won't go around stinging everybody in the place. And besides, you're smoking up the city and messing up the boiler for no good reason at all. That smoke is too high to affect the flavor of the honey, and all it does is make everybody sore."

He went over to the burners and adjusted them while One-Sock looked on without a peep.

"Murphy," he said, "it's your job to run this boiler plant the best you know how, and to raise bees the best you know how. You can be a champ at both jobs, because your glass jaw doesn't matter. Now, let's go see the hives, and give me some honey with that good Scotch flavor, for the Ladies Association for City Improvement. We've got to smooth 'em down."

One-Sock looked at me and grinned again.

"John, this guy knows things. Wanta see the hives, too?"

"Sure," I said, and I really did. "And how about some honey for me?"

That night I put out two mice for Oscar. For an owl, he certainly understands people.

TROUBLES WITH IRREGULARLY USED WELLS AND PUMPS

By W. B. KENNEDY

SHORTLY AFTER a grammar school opened last fall, the following well and pump troubles developed: There had been a gradual failure of the water supply, but apparently no one noticed it until the lunch room water tank went dry. Upon investigation, it was learned the belt which hooked the ¾-hp motor to the automatic pump was broken. The school's janitor put on a new belt, making it so tight as to force the pump into motion even under unsuitable operating conditions. It seems some water was furnished for a time; but when things went dry again after a few days, it was found the motor (which was not equipped with a thermal overload device) was burned out.

Renewal of the motor, however, did not correct the trouble. The pump did not deliver any water when put in motion. When the lunch room operator had to start hauling water from an open spring in the community, or shut down, the school officials got busy and called in an expert well man. He tried out the pump, after the officials reminded him a new motor had been installed; but he also failed to get the pump to bring any water to the surface, so he was forced to suggest removing the pump from the well for an examination.

You may be able to guess what the trouble was, after considering the fact the well had been trouble-free for two years, but was idle four months in the year and used regularly the other 8 months during the regular school term. When the driller moved in his rig, pulled out the pump, and examined it, he found the strainer clogged with fine sand and irony slime or rust-like material. I was told by one not experienced in well matters that the foot valve was clogged with sand. If this was true, such a condition does not long exist in a well furnishing an abundance of water, providing there is no hindrance to its getting into the foot valve and cylinder; but in this case, it is evident such a hindrance existed in the clogged strainer. Also, soupy sand never chokes a piston, provided the latter is immersed in free water. I believe this type of "choking" occurs only when the water level is too low with regard to the position of the foot valve, piston, etc., or in case water movement is impeded or entrance blocked by a clogged strainer, as above.

In this case, the pump was cleaned out and a new strainer put on, and put back into the well to the same depth as formerly. However, when it failed to give satisfactory results, it was decided too much quicksand had crawled into the hole, lessening

"Just for argument's sake, Frupp, let us suppose something has happened—Now what would you do if ——"

the amount of space required for a sufficient reserve supply of water. After "washing out" the hole to a depth of 26 additional feet in quicksand and re-inserting the pump, it gave entirely satisfactory results.

At the original time of drilling, this well was made 118 ft deep and as it furnished an abundance of water for two years, I believe the basic cause of the troubles developing later was the idle period of four months between regular school terms, instead of lack of depth, lack of water in the hole, or improper straining facilities, since any well containing matter tending to coagulate may "seal up" most any strainer during a four-month period of inactivity of pump and water. Any fine particles present in the water tend to settle into every available crevice during such a long period of inactivity. If the well had been in continuous use, this trouble, no doubt, would not have occurred, at least in such a sudden and severe form.

However, one may also take the other side of the argument, contending the hole was not deep enough in the first place, or there was not enough reserve supply to keep the water soupy after heavy pumpings, or the cylinder was not far enough below the surface of the water. Some even argue that corrosive chemicals tend to accumulate at, or near, the surface of water; (slime probably does) while heavier particles settle to the bottom of the hole. Some drillers suggest a deep hole, 50 ft below the water-bearing sand, provided the bed is not too thick, and a deep pump setting; but the chief objection to this is that too much stale water is always present in the hole where such a well is used for drinking water.

A dozen different solutions to this problem might be offered; but if a water's chemical and floating-matter content is such that it tends to clog strainers, any well subjected to long periods of disuse may develop the above described trouble unless the pump is pulled out for a lay-up during such periods — and who cares to go to this trouble? An individual wouldn't do this, and publicly-owned wells and pumps can certainly expect to be ignored as long as nobody goes thirsty.

How Would You Stop This Leak in a Concrete Wall?

Nothing to it, you say? . . . But wait! . . . This was a very thick wall and it had a lake 65 miles long and several feet deep on one side of it . . . They couldn't possibly unwater the lake, and the inlet of the leak could be almost anywhere under the water on the upstream side . . . The repair crew was stumped, when along came a "tramp" mechanic, who showed them how to stop the leak quickly, simply and inexpensively . . . Here's what he did

By H. B. McDERMID

CONSTRUCTION of a large hydroelectric plant was rapidly approaching completion when a bad leak developed in a very heavy concrete wall that had just been placed under water pressure for the first time. This leak was a puzzle to some of the mechanics who had to repair it somehow. The pool, being filled behind the mile-long dam, was 65 miles long, and the point where the leak showed up was several feet below the surface of the pool. Considering the thickness of the wall that was leaking, the up-stream end of the leak might be anywhere in a wide area.

In thin walls, such a leak can sometimes be stopped by pouring ashes and cinders down the flooded side of the wall, as close as possible to where the leak is suspected to have its source. The current produced by the leak will suck ash particles of varying sizes into the leaking hole, gradually stopping the leak. But to cover in this way all possible leak sources on the pool side of a thick wall like this might take carloads of ashes, and then end in failure to cover the up-stream end of the hole, and so fail utterly to stop the leak.

To unwater the pool was unthinkable. Even if it could be done, more than likely the up-stream end of the leaking hole would then be nearly as hard to find and plug.

The repair crew was discussing how they could place and hold a concrete plug on the down-stream side of the wall, against several feet head of water. But they didn't seem to be getting anywhere. Then along came a "tramp" mechanic* and joined in the meeting. He took a look at the leak, grinned, and said "Why, that's easy! If you want, I'll fix it for you, and tomorrow morning you can forget all about it." The gang boss gave the stranger the green light and the repair gang watched closely to see how he would proceed.

Editor's note:—At this point, stop and look at Fig. 1, then ask yourself, "What would I do in a case like this?" Then turn the page and see what the "tramp" mechanic did. Would you have done the same thing? Or do you have a better solution?

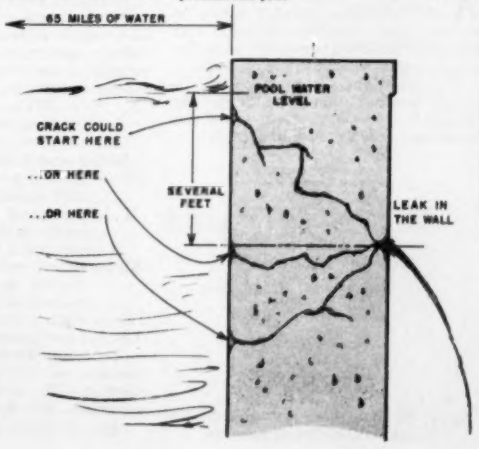


Fig. 1. Here's the problem: the lake on one side of the wall couldn't be unwatered; the upstream end of the crack might be anywhere; would be very hard to find under water; couldn't be plugged with concrete or ashes. How stop this leak?

*Editor's note:—This is not, of course, an accurate name for mechanics and construction men who travel around from job to job as they please, rather than becoming permanent members of one company. They are often referred to by the permanent workers as "tramp" mechanics; however, they are anything but tramps. They are usually highly-skilled, with wide experience and ability, as this little story shows. It's just that their feeling of independence is more important to them than a settled, permanent job.

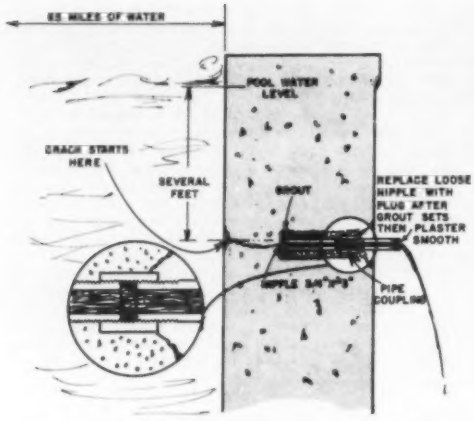


Fig. 2. Here's how the tramp mechanic stopped it, by using the same principle that is used in building a big dam in a running river. You don't try to stop the flow but you arrange a spillway or bypass that can be plugged when desired and let the water flow through that while you are damming around it. That is just what the mechanic did here

Here's How He Did It

The mechanic appeared shortly with a rather large hand concrete drill and a hammer, a couple of ¾-in. by 3-in. pipe nipples, a ¾-in. coupling and a pipe plug. He first drilled a hole in the concrete wall, starting where the leak appeared and following the hole back into the wall as best he could, until it was deep enough to suit him. Then he deformed one end of the nipple, and on the other good end of that nipple he screwed the coupling. Next he made sure the nipple and coupling could be shoved into the hole deep enough, so that the outside end of the coupling would be well back from the outside surface of the wall.

Next he screwed the second nipple into the coupling, loosely by hand, leaving it projecting far enough from the surface so that the leaking water would now flow through the pipe nipples and fall clear of the wall.

Now he took damp grout, good and rich, and tamped it into the hole tight all around the pipe nipples he had placed. The water flowed through the pipe and relieved the freshly placed concrete of all pressure, but allowed it to set undisturbed, with its outside surface well inside that of the wall.

Next morning the mechanic came back, screwed out the loose nipple from the now tightly-set coupling, and set in its place the plug that was ready. Now the leak was all stopped and it only remained to plaster the depression over smoothly. As soon as that patch had set well, anybody would find it very difficult to point out where the leak had been.

Many of these "hobo" mechanics one sees around heavy construction work are full of tricks like this one. This fellow sure had "what it took" to make a puzzling job for the less-experienced look like an easy one when the man with the "know-how" came along and took over.

Hydropneumatic Tank Operation

A discussion of basic principles together with a description of various systems in use. Formulas and methods of calculating operating range are given

By **HAROLD NICKELSPORN**
Consulting Engineer, Hoboken, N. J.

ALTHOUGH there are thousands of hydropneumatic tanks in service, there is much confusion and misunderstanding prevalent as to the proper operation of these systems.

The installation and control of hydropneumatic tank systems can be simple if a few basic elements of the expansion of air are analyzed.

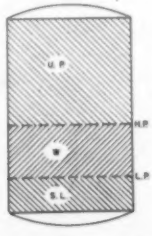


Fig. 1. Sketch showing the three divisions in hydropneumatic tank operation

Boyle's Law

The basic rule stems from Boyle's Law which states that temperatures being constant, volumes of a given weight of gas vary inversely as the absolute pressure. Expressed simply:

$$P_1V_1 = P_2V_2$$

where, P = absolute pressure
V = volume

In the sketch Fig. 1:

UP = unused portion, percentage tank volume
W = working withdrawal per pump cycle, percentage tank volume
SL = safe limit of liquid withdrawal at low pressure, assumed at 10%
HP = High pressure, absolute
LP = Low pressure, absolute

Applying Boyle's Law to the expansion of the air in the unused portion, UP, of the tank at the high pressure, HP, the following results:

$$HP \times UP = LP\ (UP + W)$$

Solving for W, the withdrawal per cycle:

$$(1)\quad W = \left(\frac{HP \times UP}{LP}\right) - UP$$

Also using the rule that the whole is equal to the sum of all the parts, the following relation exists:

$$W + UP + SL = 1$$

substituting, 10% for the safe limit,

$$(2)\quad W + UP = 0.9$$

solving for UP in equation (2) and substituting in equation (1), the following results:

$$W = \left[\frac{HP}{LP}\ (0.9 - W)\right] - (0.9 - W)$$

Solving for W, in terms of HP and LP

$$(3)\quad W = \left[\left(\frac{HP}{LP} \times 0.9\right) - 0.9\right] \div \frac{HP}{LP}$$

Substituting in equation (3) for different values of the operating pressure ratio, HP/LP, the accompanying table is compiled. This table indicates the proper high and low level operating range of a hydropneumatic tank for maximum, W, the working withdrawal per pump cycle. These levels when used will

Table computed from Equation 3. To show operating range for W maximum

Press Range	HP/LP	Useful discharge % Tank Volume	High Level Setting % Tank Volume
SAFETY LIMIT — 10 PERCENT			
20-30	1.28	19	30
20-40	1.57	33	43
20-50	1.86	41	51
20-60	2.14	50	60
20-70	2.43	53	63
30-40	1.22	16	26
30-50	1.44	28	38
30-60	1.67	35	45
30-70	1.89	42	52
40-50	1.18	14	24
40-60	1.36	24	34
40-70	1.56	33	43
SAFETY LIMIT — 20 PERCENT			
Pressure Range	HP/LP	Useful Discharge % Tank Volume	High Level Setting % Tank Vol.
20-30	1.28	18	38
20-40	1.57	29	49
20-50	1.86	37	57
20-60	2.14	42	62
20-70	2.43	46	66
30-40	1.22	15	35
30-50	1.44	24	44
30-60	1.67	32	52
30-70	1.89	38	58
40-50	1.18	12	32
40-60	1.36	21	48
40-70	1.56	28	48

give the least number of pump starts per hour which is extremely desirable.

From the table, it is clear that the control of tank operation must be a combination of water levels as well as pressures.

Two Systems

It should be noted that in practice there are two distinct problems in hydropneumatic tank control that will be encountered.

The first is that of deep well pumps. These installations will receive a charge of air each cycle of the pump operation. The air will seep in the well column through the pump shaft packing and the air in the column will be discharged into the tank on each cycle. This air must be eliminated by the control or else "air binding" will result.

The second problem is that of a submerged suction pump where air must be added to the tank or else the tank will become water logged. This results because any air in the system will be gradually absorbed by the water in the tank and unless air is automatically added to the system, a rising water level will result, which will water log the tank.

Controls for Deep Wells

A discussion of controls will be broken down into the two types of systems just described.

In the first group, excess air must be eliminated. In the second group, air must be added to the system to provide for any deficiencies.

One type of control for the first group consists of a wide range pressure switch to start and stop the pump, and, also, a float valve set at the lowest safe limit of the system. This float valve releases air whenever the water limit should go below the safe limit of the tank. This is indicated in Fig. 2 A.

Another set of controls uses a floatless electrode control to start and stop the pump. The excess air is received by means of a solenoid valve energized by a pressure switch contact. This switch has a contact that closes whenever the pressure rises above the maximum operating pressure of the system. Whenever the contact closes, the solenoid opens up to relieve the excess air. The settings of the electrodes should be obtained after the maximum operating pressure range of the systems has been determined. When these values have been set, the ratio of HP to LP can be calculated and the proper operating range be selected. This will give the minimum number of pump starts per hour. This system of control is indicated in Fig. 2 B.

A third type of control uses a pressure switch set at the lowest permissible pressure, LP, to start the deep well pump. Once the pump starts, the control is shifted to a float switch which stops the pump when the high level in the tank has been reached. When the float switch stops the pump, a second pressure switch set at HP will close when there is an excess of pressure in the system. This energizes a solenoid valve which opens to emit the surplus air. This third type of control indicated in Fig 2 C is the most expensive and should be used only where extreme accuracy and adjustability is required.

Controls for Systems With Submerged Suction Pump

As noted previously, submerged suction pumps have a deficiency of air and control must be arranged to provide a change of air into the tank when required.

The first type of control to be described for these systems can only be used with a snifter valve placed on the suction side of the pump. A snifter valve is a regular bicycle pump tire fitting. This control indicated in Fig. 3 A uses a wide range pressure switch to start and stop the pump. A float valve set at the upper level opens an orifice whenever the float rises above the upper level. This indicates there is a deficiency of air in the system. The orifice in opening permits air to be supplied to the snifter valve. This air is then sucked into the suction manifold of the pump and discharged with the liquid into the tank.

A second type of control indicated in Fig. 3 B utilizes a floatless electrode control to start and stop the pump at the high and low limits. This system also requires a pressure switch which will close whenever the pressure falls below the lowest operating pressure required in the system. This indicates air is required in the system. The pressure switch then is used to start an air

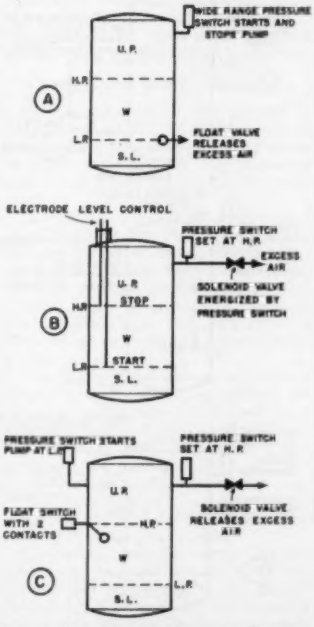


Fig. 2. Controls for Group I Systems. Deep well pumps

compressor to add air into the system. If there is an air receiver in the plant with sufficient pressure (at least greater than the lowest pressure LP required in the system), this air compressor can be replaced with a solenoid valve. This solenoid valve when energized will open up to permit air to leak out of the air receiver and recharge the hydropneumatic tank.

The last type of control indicated in Fig 3 C utilizes a pressure switch to start the pump at LP and a float switch to stop the pump at the upper level. This control is similar to that described in sketch C. However, the difference is that the pressure switch set at HP energizes an air compressor to start and charge the system when required. This air compressor can also be replaced with a solenoid valve and a plant air receiver as in the preceding example.

Safe Limit

In this discussion a safe limit, SL, of 10 per cent of tank capacity has been used. This figure should only be used on those installations where the pump capacity is greater than the maximum load on the system in gallons per minute. With a system as just described, the hydropneumatic tank is only used to even out the pressure fluctuations of the pump and to provide for as few starting cycles of the pump as practical. Thus, with a lower safe limit, a greater working discharge, W, per cycles is obtained and the pump will not start too frequently.

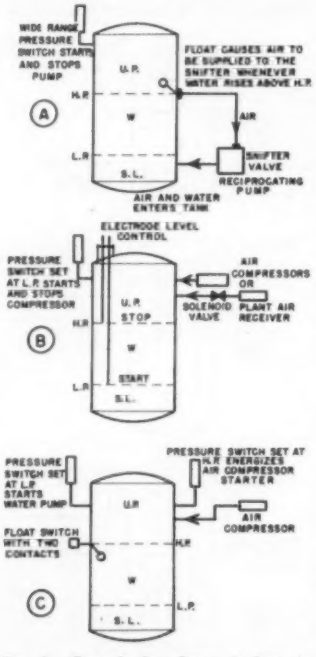


Fig. 3. Controls for Group 2 Systems. Submerged suction pumps

The running current of a motor is much smaller than the starting surge current and it is best practice to cut the number of starts down to a practical minimum.

The control should be equipped to automatically release any air pressure from the tank if the water level should ever fall to the point where air starts to enter the mains. This is important, as in the event of a pump break down, it is highly probable that air under pressure will enter the mains and cause maintenance problems in the system.

If there is a probability that the pump capacity may not equal the system capacity for short periods, the safe limit should be set at a higher value: 20 per cent of tank capacity is a commonly accepted value in these systems. This is to provide for uncovering of the tank outlet at periods of maximum draw on the system. For this reason, whenever possible it is best to provide the outlet as low down on the tank as possible. A table has been provided for both 10 per cent and 20 per cent Safe Limits.

Whenever possible the pump should be selected large enough to handle peak loads. It should be noted that where this is done, a low safe limit is used and the tank does not have to provide for any storage of water.

The tank capacity when this is done should be only large enough to provide for enough discharge per cycle, W, so that pump will start only about 6 times per hour.

Tank Capacity

As an example of calculating tank size assume a pump rated at 100 gal per min, and a pressure range of 20 to 40 psi. This will give a maximum discharge of 33 per cent of tank capacity per cycle, using 10 per cent as the safe limit, SL.

With a draw down of just 100 gal per min on this system, the pump will operate continuously. With a draw out of 50 gal per min, the pump will have a maximum number of starts. With 6 starts per hour, this means the pump will run for five minutes and stop for five minutes on recurring cycles.

During this ten minute cycle the system will absorb 500 gal of water. The pump will supply 250 of these gal and the tank will have to supply the other 250 gal. Thus, the tank capacity should be 750 gal, as with 33 per cent working discharge per cycle W, this tank will provide the required 250 gallons.

A commonly accepted method of calculating tank capacities is to multiply the pump capacity in gallons per minute by 10. This gives a safe value and is an extremely simple and expeditious method of calculating tank capacity required.

Summary

Hydropneumatic tank control depends upon the proper relation between air and water volumes as well as the correct selection of high and low operating pressures.

The tables given in this article will give an easy method of selecting the proper high and low level limits once the proper operating pressure range has been selected.

Next the pump and tank capacity should be selected as described. The last step is to select the proper control to maintain the satisfactory balance of air and water, thus getting maximum utilization from your hydropneumatic tank.

MODERN WIRING METHODS IN HOLLAND

By H. WIELAND LOS
Zaandam, Holland

SINCE THE METAL-CLAD electric light installations were introduced in Holland practically no new developments of a fundamental nature have been made. In cases, however, where the demands of the installation required a multiplicity of joints and junctions, a special outlet and junction box was developed with a view of decreasing the number of fittings and wire splices. This box is intended to do away with the different types of 2-, 3-, and 4-way junction

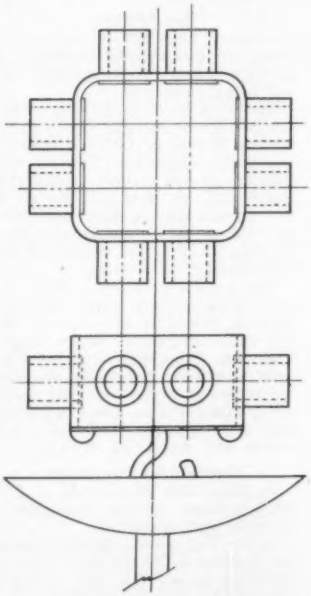


Fig. 1. Eight-way outlet and junction box

Fig. 2. Patented connectors making ordinary wire splices unnecessary

boxes. With this box, all splices are stored away in the new 8-way central boxes located directly above the lighting fixture as shown in the accompanying sketch.

This box was introduced in conjunction with a patented system aiming at concealing all parts of the installation without the need for special building structure provisions for wire pulling. Only the lids of the boxes are made flush with the ceiling and only these lids are exposed. Later, as shown in the sketch, they are rendered invisible by the lighting fixture. Two of the 8 openings in the box are reserved for the feeder lines, the remaining 6 being available for switch and other circuits.

At the same time the older type of taped wire splices and the use of compound has given way to the use of shells of ceramic material. One type is shown in Fig. 2. The wires are stripped, twisted, and spliced by means of a knife and a pair of special pliers. Solder is never used.

Simplified Process for Determining Steam Purity

MOST TROUBLESOME of all the problems in measurement of steam contamination by electrical conductivity is that of preventing gas contamination or degassifying a contaminated sample. Because dissolved gases often combine chemically with the condensate, the best solution for this problem is to prevent the initial contamination of condensate as it is formed in the sampling and measuring system.

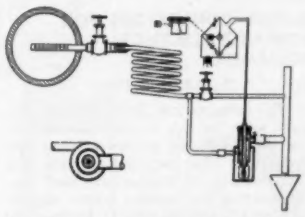
This can be accomplished if the steam sample is drawn off at high velocity in such a manner that the exposed surfaces of the condensate particles are thoroughly scrubbed by steam passing through the sampling tube. If this passage is at high velocity, condensate particles clinging to the wall of the tube and those torn from the wall of the tube by the steam, all tend to lag behind steam flowing through any increment of the sampling line. This assures that the exposed surface of all condensate particles are at or very close to the boiling point for the pressure established at any particular point in the sampling line.

The sketch shows apparatus required for the sampling and collection of condensate without gas contamination along with a schematic electric diagram for measurement of specific conductivity. It was described in detail by S. T. Powell, I. G. McChesney before the Annual ASME meeting, New York, November 1950.

How It Works

Sample enters a standard sampling nozzle in the steam main, passes through a high-pressure stainless steel gate valve and into a sampling line of stainless-steel capillary tubing, shown in form of a coil. Actually, this tubing may be 50 to 150 ft long, since it serves as an orifice to limit the total sample flow, and also as an air-cooled radiating condenser, which will deliver a mixture of steam and condensate to the apparatus. In practice, any excess of sampling line between nozzle and conductivity unit is formed into a helix or flat serpentine on a rigid mounting.

Apparatus is designed for use when sampling steam in a pressure range from somewhat above atmospheric to extremely high pressures and it discharges at atmospheric pressure. Because of constant discharge pressure, automatic temperature compensation is not required.



Apparatus for measuring specific conductivity of high-pressure steam samples

Flow of sample to the cell can be adjusted by using proper length of sampling tube or preferably by sampling at a rate in excess of requirements for the condensate cell and passing the excess through a bypass line to a vent, as shown.

The partially condensed sample of steam and vapor enters the condensate cell, where the electrical conductivity is measured, and is finally discharged to waste.

Steam, condensate, and gases enter this cell tangentially and, while the condensate particles are collected and flow down the walls of the condensate cell, their exposed surfaces are being continuously scrubbed by steam. Level regulation in this condensate cell is automatic, particles being thrown from the condensate surface out through the discharge pipe. As the condensate surfaces approaches the vertical outlet pipe, an orifice is formed causing an appreciable pressure drop at the surface of the condensate. High turbulence and surface boiling is the result.

This not only carries away excess condensate, but prevents absorption of gases in the condensate that is temporarily collected within the cell. Turbulence caused is useful in thoroughly mixing condensate held in the cell. Length of travel through the discharge passage is sufficient to prevent the diffusion of gases from the atmosphere back through the discharge and into the cell. The conductivity electrodes inserted in the condensate cell thus measure the specific conductivity equipment.

For Pressure Below Atmosphere

If the pressure of the sample is below that of the atmosphere, it is most convenient to use cooling water in order to condense the required amount of steam for the conductivity reading.

Successful operation requires:—(a) Pressure drop across the sampling and measuring system sufficient for turbulent flow at fairly high velocity throughout the system; (b) cooling agent other than air because the sampling line and coil may be close to or below the ambient temperature.

The paper gives details of a steam sampling and measuring system set up on an evaporator at Russell Station of The Rochester Gas and Electric Corp. to measure the contamination of the discharged steam. The evaporator pressure varied between 25 psia and 10 psia. This installation required the use of condensate for cooling the sampled steam.

Operating tests and early experiments on two installations at 650 psi carried out in February and March 1948 are also described. References are given to previously published literature on this subject—ASME Paper No. 50-A-85.

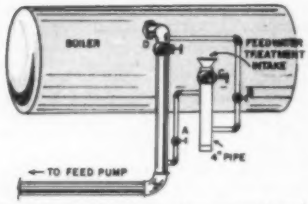
PRACTICAL HINTS AND KINKS

BOILER FEEDWATER TREATMENT INJECTION

By HOWARD T. BAILEY

OPERATING ENGINEERS are becoming more conscious all along of the extreme importance of proper boiler feedwater treatment.

In new installations, necessary pipe connections are usually made to take care of feedwater treatment;



To add water treatment, close valves A and B, open valve C, pour in chemical. Then close valve C. Next open A and B. Valve D should be closed when forcing mixture into boiler

but in many instances of older installations no provisions were made for this purpose.

A means of doing this without wrecking the whole feedwater system sometimes constitutes a perplexing problem to the engineer in charge.

To accomplish this we made the simple arrangement shown in the sketch and to this date the water analysis indicates that the system is working properly.

QUICK OILER REPAIR

SOMETIMES a crack will develop in the bottom of a spring bottom oiler, or abrasion may produce a small hole elsewhere, thereby permitting oil to leak from the oiler. This annoyance can be temporarily eliminated, until the defect can be soldered, by placing a piece or two of scotch tape or oil-proof electrical tape over the opening as shown, provided the defect is on a surface that can be effectively covered.

SANDBAG-LOADED DRUM SUPPORTS GAS CYLINDERS

IT REQUIRED a compound fracture of a rigger's leg, occasioned when a fork lift truck tipped over a set of oxyacetylene cylinders, to bring a local firm up to the stark reality of serious trouble and expense that could have been so readily avoided.

Lacking the conventional two-wheeled cart and appurtenances and being unable to purchase one because of the tight steel situation, the foreman showed ingenuity in adapting the best the situation afforded when he loaded bags with sand and dumped these into an empty drum to form a "deadman" against which the cylinders could be securely lashed. When moving time is at hand the bagged sand is easily shifted to a wheelbarrow and moved to the next job.

That wheelbarrow, too, is an adaptation since one with a leaking tray was selected to have a section cut out in the front lip to enable two cylinders to nest snugly in line with the wood handles. Reinforcing was added to stiffen the otherwise flexible metal.

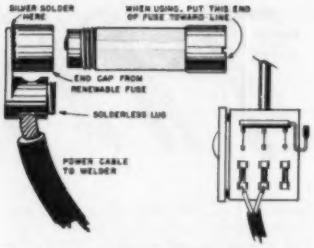
HANDY CONNECTORS FOR PORTABLE ELECTRICAL EQUIPMENT

By ARTHUR HOLT

WE FREQUENTLY have minor repair jobs for our a-c arc welder in various outlying places around the buildings. This requires a quick and easy means of connecting and disconnecting the welder power supply cables (230 v, 60 amp). Permanent wiring would not be justified, as the machine may be needed for two or three minutes' work in a location where it will never be used again.

With these thoughts in mind, we made up the handy connecting arrangement shown in the sketches. Solderless lugs were silver-brazed to the end caps of 60-amp renewable fuses. The welder power cables were entered into the solderless lugs.

Now, when we want to weld anywhere around the buildings, we can always find a fusible motor switch or distribution panel within reach of the welder cables; and it is only necessary to remove the load from the circuit, take out two of the regular fuses, and snap the special connector fuses into place until the welding is completed.


SILVER SOLDER HERE
WHEN USING, PUT THIS END OF FUSE TOWARD LINE
END CAP FROM RENEWABLE FUSE
SOLDERLESS LUG
POWER CABLE TO WELDER

Sketches showing the construction and use of the homemade connection

As with other temporary wiring, due caution should be used with this arrangement. If the welding outfit is to be used in one place only, permanent wiring in accordance with the National Electric Code should be installed.

EFFECTIVE OUTDOOR TANK INSULATION IN FOUR STEPS

THE APPLICATION of insulation and weatherproof finish on an outdoor storage tank in the Midwest illustrates the four steps in an effective technique for insulating large, cylindrical vessels. In the photograph, the tank, which will operate at 270 F, is being insulated with 1½-in.-thick mineral wool blankets, in 24 by 48-in. sections, covered with expanded metal lath on one side and wire netting on the other.

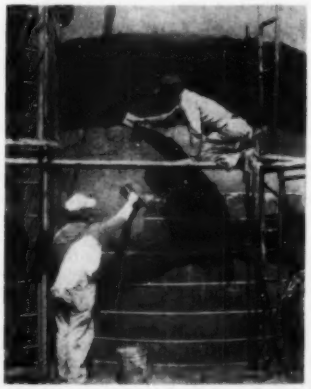
From bottom to top in the photo, the four steps are:

(1) Mineral wool blankets, metal lath covering on the outside, are tightly butted together and secured to the tank by 1-in. galvanized iron bands encircling the tank on 9-in. centers.

(2) A single ¾-in. layer of insulating cement is troweled into the metal lath covering.

(3) 1-in. mesh wire netting is stretched over the dry cement.

(4) A coat of asphalt mastic, ⅛-in. thick when dry, is troweled into the wire netting and smoothly surfaced



Photograph showing steps in insulating tank

to finish the tank insulation properly.

The insulating materials and steps illustrated are designed to maintain the temperature of the tank contents under all weather conditions with minimum maintenance and repair.

TRANSIT LEGS STEADIED BY WEIGHTED BAGS

ON SOME JOBS the need for haste or the lack of coordination between foremen results in a finished floor being laid in much of the building before the heavy machinery is all installed. Since the use of a transit is imperative for precision setting and grouting operations it means that the engineer finds himself out on terrazzo, composition tile, or slick finished concrete as he sets up transit.

One engineer has licked the problem easily enough by having the shop fill six 5-lb bags of coarse cast iron cuttings. Two are thrown about each leg as the setup is made and no ordinary amount of vibration will dislodge the setup, even a little bit.

Wax crayon is used to make point and the janitors honor these as they pass with the mechanical scrubbers and waxers.

For point identification on tarvia or other bituminous paving something better than the conventional spike is now used. The spike soon rusted to the color of the pavement and was hard to locate. The new stunt is to drive an 8-penny nail through a bright tin washer, normally used to nail down tarpaper. One can see that at any reasonable distance.

AUTOMATIC CUSHIONING DASHPOT

By JOSEPH H. STEWART

DESPITE THE greatly increased use of steam turbines there are still a great many Corliss engines in use throughout the world. Many of these engines have been running for 25 years or more and are still giving excellent service.

I happen to be a road man for a large engine manufacturer and in my travels in this country, Canada, Mexico and the West Indies I have occasion to service many of these engines and as a consequence of years of experience in this field I long ago came to realize that the one weak point of a Corliss engine is the dashpots. I always wanted to try out an idea I developed for making a dashpot that would be automatic in operation. During the past two years I have had the opportunity of trying out this idea with very favorable results.

A cross section of this dashpot is shown in Fig. 1. It consists of a stationary cylindrical pot A on top of which is bolted the shallow air cushioning chamber B. Into this pot is placed a removable plunger C. A coiled spring D is held down by the cushioning chamber B.

E is the cushioning plunger which is threaded on to the top of the plunger C, and locked by set screw F. As shown, there is a ball bearing G on the end of dashpot rod H by which plunger C and cushioning plunger E are raised. A ball check valve is in the bottom of pot A to release any air due to leakage past the plunger C. L is a hole in the plunger E to release air trapped in cylinder B.

In operation the valve gear of the engine lifts the plunger C by the dashpot rod H, creating a vacuum in the bottom of the pot A, and at the same time raising the cushioning plunger E out of the cushioning chamber B. This movement allows air to completely fill chamber B and compresses the spring D.

When the engine valve gear releases the dashpot rod H, the action of spring D and the vacuum under plunger C causes plunger C and the cushioning plunger E to drop instantly. As the cushioning plunger E enters the cushioning chamber B, the air is compressed and forced out gradually through hole L, thereby cushioning all the moving parts and bringing them to rest without shock. As the size of the hole L is predetermined by test to suit the size of the cushioning chamber B, the entrapped air is forced out at the proper speed for correct cushioning; hence, there is no necessity for

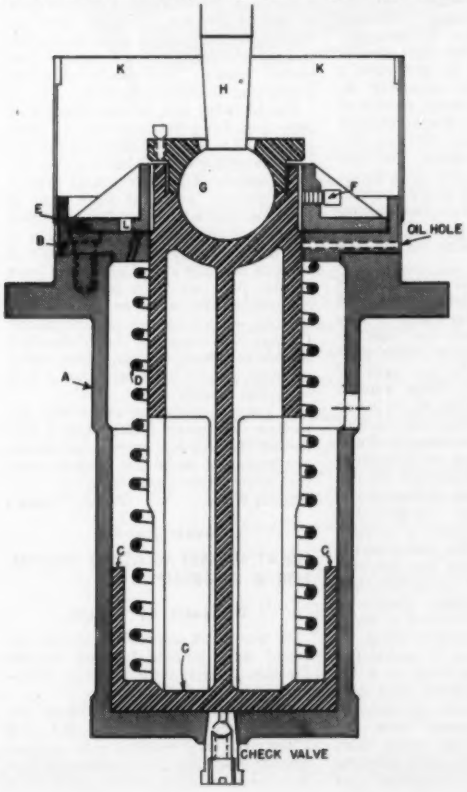


Fig. 1. Cross section through automatic dashpot

Fig. 2. General view of dashpot

manual adjustment regardless of the height of lift of the plunger C in pot A.

I have had a number of these dash pots in actual every-day service for over a year and these have given 100 per cent perfect results. They are quick as lightning and are never touched; in fact, there is no adjustment that can be made on them; they are really automatic.

Further information on this dashpot may be obtained by writing Automatic Dashpot on the no-postage postcard on page 35 and dropping it in the mailbox.

Questions and Answers

Question No. 481

HOW DO YOU ACIDIZE A WELL?

WHAT IS the process known as acidizing a well—a water well, that is? Why is it done? How is it done? Can any engineer get the equipment and materials necessary to do it, or must it be done by specialists? Is the process used widely all over the country or is it just used in some sections of the country?

Chicago, Ill. K. R. H.

Answer No. 473

WILL THIS SHUNT WOUND GENERATOR FIT HIS CONDITIONS?

CAN HE operate a new shunt-wound d-c generator, driven by a steam turbine, in parallel with five compound-wound d-c generators driven by steam engines? What sort of regulator would he need to use on the shunt-wound machine? These questions were asked in the October issue by J. B., who gave many other details of the setup in his industrial power plant.

In the December issue, C. O. von Dannenberg made some suggestions: (1) use a rheostatic type regulator or (2) let the turbine-driven generator take constant load or (3) rewind the shunt generator into a compound unit.

Here are more ideas from a reader in England. Quite obviously, he has had personal experience with just this problem, for he gives a very practical solution for it—and you don't need to buy a dime's worth of equipment. You've already got all you need.

Proper Governor Adjustments Will Do It, Says Easton

IN THE industrial plant mentioned, it is not clear whether the steam turbine is designed to operate purely as a "pressure-reducing valve," delivering all steam to process, or whether a condenser is also provided to enable power to be developed irrespective of the demand for process steam.

If all steam is delivered to process, the shunt generator may be made to operate satisfactorily in parallel with the existing compound-wound units by arranging the speed governor on the new set to be inoperative under normal conditions. This is done by screwing up the adjustment to a position somewhat above normal speed, say 5 per cent, after the generator has been switched on to the bus bars. In these circumstances, the load on the set will be controlled by the amount of process steam passing through the turbine and the bus voltage by the other generators.

Assuming initial steady conditions, in the event of a greater power demand from the plant, without increase in process steam, this will be carried by the engine-driven generators, since the turbine is already giving maximum power corresponding to that steam volume. On the other hand, with increased demand for process steam, the turbine develops more power, the unit speeds up slightly, tending to generate a higher voltage. This operation in turn results in increased electrical output, for the bus voltage remains substantially constant. With a reduction in process steam, the reverse action occurs: the unit drops speed slightly and the power output falls to a new value corresponding to the revised steam flow. The conditions are automatically maintained and are quite stable.

A number of units operating on this principle have been built and are running satisfactorily. The change in speed from no load to full load will be of the order of 5 per cent; i.e., $\pm$ 2½ per cent of normal speed, giving some margin on the governor setting of + 5 per cent. Operating in this way, it will be found that the basic speed of the set can be controlled by adjusting the generator field regulator, an increase in field current reducing the speed and vice versa. In attended stations, this provides a simple means of regulating the speed and if necessary, of reducing the no-load to full-load speed variation; alternatively, the latter may be achieved by the addition of a small amount of positive compounding.

With the proportion of additional to existing plant mentioned by J. B., it appears most unlikely that circumstances will arise in normal operation when the power from the process steam will be more than sufficient to supply the total electric load on the plant; therefore the speed of the turbine generator should always be maintained within reasonable limits. However, even if this is not so, the normal speed governor will come into operation to close the throttle valve when the speed has risen to about + 5 per cent and the set will continue to run at this speed supplying all the electric load but passing a reduced quantity of process steam.

If a condenser is being used, this scheme will not be practicable because the initial screwing up of the speed adjusting gear will load the turbine to its maximum capacity, which will be held irrespective of the demand for process steam or electric power, the extra steam above that required in the plant passing direct to the condenser.

Birmingham, England V. EASTON

Answer No. 476

WHY DID HIS POWER FACTOR CHANGE?

Different Uses of Same Equipment May Do It

POWER FACTOR can change from day to day without a change being made in the equipment used. The change is caused by the way the equipment is used; that is, by the nature of the load. Power factor of an induction motor can be as high as 90 per cent if run at 100 per cent load, and as low as 50 per cent at light loads. An industrial plant's excessively low power factor is usually due to underload induction motors.

Could it be that in the months of May and June the load was so synchronized in the mill that the motors were running with a full load or almost full load, which would give a good power factor so high that it gave an over-all power factor of 81.5 in spite of the load characteristics of the air compressor motor? Could it be that in July and August the load of the mill was not so well synchronized, and some or all the mill motors were running underloaded? Or has the capacitor been checked for blown fuses, broken wires, dirty or loose connections, or even a bad capacitor itself?

A lot of factors can enter into the picture of power factor, but I feel the two causes just mentioned above are more apt to be the answer from the information given by J. G.

Puerto Rico W. O. TATMAN

Answer No. 477

WHAT IS BEST HEATING SYSTEM FOR A CHURCH?

Comments by Tatman

IT WOULD BE impossible to recommend any definite heating system for this church with so little information.

Choosing a heating system involves much careful thought and study and only when one is in possession of all the information, such as details of building construction, type

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of wall construction, type of attic, if any, basement area, the building's exposure, average weather to be expected, number of hours per week the building will be used, and will the first cost of the heating system or the fuel bill from year to year be the paramount consideration.

I can, however, give a short description of the different heating systems, their good and bad features, and hope it will help solve the heating system problem.

Hot-water heating system—This system is the aristocrat of heating systems, and to my mind one of the best, but only when properly installed and where the saving in fuel will justify its cost. As this system operates under a very low water pressure, it is one of the safest, it is clean, quiet, quick to heat up the building, simple to operate, has low upkeep cost, is efficient and economical on fuel.

Its principal disadvantage is high first cost. There is only one way to install a hot-water heating system and if not installed by men who know how, it will never operate satisfactorily. Hot water radiators never radiate as much heat per square foot of radiator area per hour as do steam radiators because the water temperature will be around about 170 F, while that of steam can be around 240 F. One will need about 30 per cent more radiator area with a hot water heating system than with a steam heating system.

Steam heating system — Steam heating systems can be broken down into three classes. 1—The vapor system; 2—The single-pipe system; 3—The double-pipe system.

The vapor system is rather a cross between the hot-water system and the steam system. With the vapor system, vapor circulates through radiators in place of hot water. This system has a lot of the characteristics of the hot water system in that it is clean, quiet, quick to heat up, operates under a pressure only a few ounces above atmospheric pressure, has not the drips or odor of the steam system, easy to control, efficient and economical to operate. Its advantages are about the same as for the hot-water system.

The single-pipe steam heating system operates the same as a two pipe system. Only one pipe is used and it serves the double purpose of delivering steam to the radiator and allowing the condensate to flow back to the boiler. All pipes must pitch back to the boiler. I do not favor this system.

The double-pipe system uses two pipes, one to convey steam to the radiator and one to carry the condensed steam back to the boiler. This system is the most common and most practical for all sizes of buildings and weather conditions, is efficient, the least complicated to install, can be forced when weather is bad and needs less radiator heating area than either vapor or hot water heating systems.

Its disadvantages are—slower to get building warmed up, for some pressures must be built up in the boiler before steam will start to circulate through the radiators. Radiators must have air vents and there can be drips and odors. Radiators will darken wall above them if not hooded and as this is a steam boiler operating under 5 to 15 psi, there can always be a chance for a boiler explosion if not properly operated.

Warm-air heating systems—Warm air heating systems are either of the gravity type or of the forced-air type. The primary function of any warm-air furnace is to transfer the heat generated to the circulating air. The operating principle of the gravity system is the difference in specific gravity of warm air and cold air. We all know hot air is lighter than cold air and will rise if cooler air is available to replace it. For satisfactory operation of this type of a system, the size, shape and pitch of the air ducts must be right to insure good circulation. It is rather hard to regulate this type of a system so that all parts of the room or building will be the same temperature; most of the heat tends to flow out the shortest ducts unless restricted with dampers. This is the cheapest type of heating system and will answer well where the building is not large.

The forced-air heating system employs the same principle as the gravity system, only a blower or fan is used to force the warm air through the ducts. With this system the pitch of the ducts can be disregarded. Heat can be delivered to any part of the building in any quantity up to the capacity of the furnace. This system is more efficient than the gravity system.

Warm-air systems are quiet and simple to operate, with low upkeep, no danger from explosions; are not as economical on fuel as a steam or hot-water system but are the cheapest to install and for some installations are more practical. With the forced-air system there will be the cost of operating the blower to add to the fuel costs.

If the heating system is going to be in service 24 hours a day, 7 days a week, five or six months a year, with low outside air temperatures, economy in fuel should be the first consideration; but if it will only be in service a few hours a week, then first cost and simplicity determine.

Puerto Rico W. O. TATMAN

Comments by Evans

MANY FACTORS enter into the selection of a heating system for a church, such as: type of construction, ceiling height, occupancy, amount of time needed to bring the building up to temperature, number of hours used per week and whether these hours are consecutive or intermittent.

If the building is tall (high ceiling), is heated many consecutive hours per week, and if the ultimate in comfort conditioning is desired, radiant heating coils with a hot-water boiler for hot water in the coils should be installed. The coils should be in the floor, spaced on 12-in. centers, and floor temperature at surface kept not above 85 F. In conjunction with the hot water panels, for humidification, filtering, and intake of fresh air, and for quick building heating, a separate conditioning unit using hot water from the boiler can be installed.

A steam heating or hot water central system using forced air circulating in ducts might be used; however, the temperature differential between floor and ceiling may be excessive. Steam heating has advantages of ease of control, quick response, low installed cost, and minimum of space required. Hot water heating has advantages of ease of control and closer control, low installed cost, fewer maintenance problems, low first cost.

The radiant panels are recommended for new construction.

Chicago, Ill. MELVIN EVANS

Answer No. 478

HE WANTS DATA ON SIMULTANEOUS FIRING OF COAL AND GAS

WHAT IS the possibility of firing coal and gas simultaneously in a 225-psi boilers, in the proportion of about 80 per cent natural gas and 20 per cent Midwest bituminous coal, the latter being burned on forced-draft type chain grate stokers? Where can he get full information on equipment and methods for doing this?, asked G.B.K. in the February issue.

Relatively Simple, Says Evans

THE PROBLEM of burning natural gas in combination with coal is relatively simple. The gas burners in sufficient quantity and with sufficient capacity to generate the amount of steam that the boiler was designed for can be installed either in the front wall or in the side walls between the side wall tubes if any. The primary air can either be run in ducts from the forced draft fan now in use, or can be supplied from a separate blower for the gas burners only. The burners should be as close to the chain grate as possible, but placed so as not to cause flame impingement on any cold surfaces and also arranged so that furnace turbulence is at a maximum. If you burn all gas, cover the chain grate with sufficient ashes for protection from the heat.

Chicago, Ill. MELVIN EVANS

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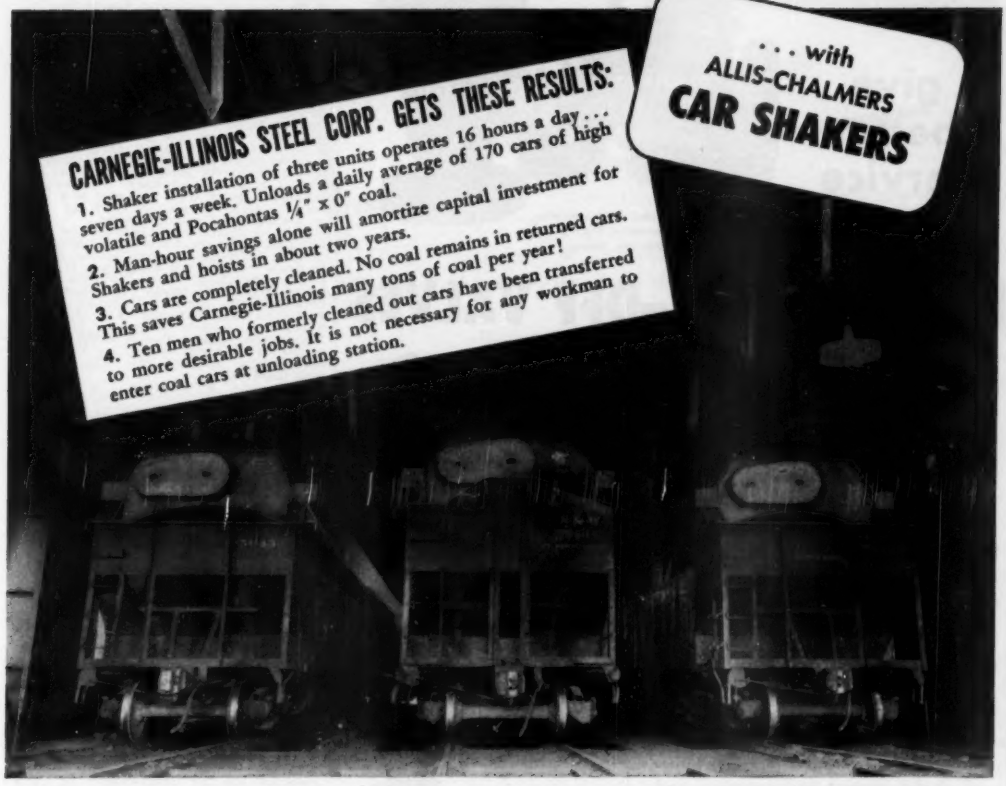
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Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Angle Blowing Valve.

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When you install an EVERLASTING Duplex Blow-Off Unit, you'll find that its many superiorities speak for themselves.

The sealing valve at the left is the EVERLASTING design that has been famous for more than 40 years . . . the valve with the drop-tight seal that actually improves with use because of its self-lapping action each time the valve is opened or closed . . . the valve that can't stick or jam because of its non-wedge design . . . the valve that opens in less than a quarter turn to provide unimpeded straight-through blow.

The blowing valve at the right is the equally famous EVERLASTING Angle or "Y" Valve, specially designed and equipped to withstand repeated blow-off shocks, erosion and corrosion, and without pockets that might trap and hold solids.

Each of these valves . . . and all the other EVERLASTING Boiler Blow-Off valve types, fully meet ASME code requirements . . . assurance that they are properly designed and amply strong for the service.

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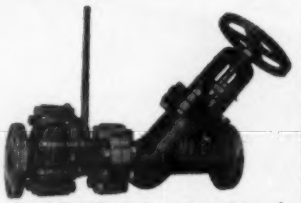

Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Y Blowing Valve.

Fig. 6571/6561. Duplex unit consisting of Y Sealing Valve and Angle Blowing Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Sealing Valve and Y Blowing Valve.

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NEWS *from* THE FIELD

Basic Reinforced Concrete Design, by G. E. Large. First Edition; 334 pages; size 6 by 9¼ in.; cloth, published by The Ronald Press Company, 15 E. 26th Street, New York 10, N. Y.; 1950; price $5.50.

This book is subtitled A Problems Method Approach and since the author, who is professor of structural engineering at The Ohio State University, has found this approach effective for 20 years, he has incorporated it in his book. The book, of course, is for use by students who are acquiring their basic understanding of reinforced concrete design.

One feature of the book is the use of large illustrations and tabulations of the various examples, with the necessary diagrams and all necessary data on the problem. This lessens the need for the instructor to make large demonstration sketches on the blackboard and leaves more time available for class discussion. At the end of each chapter there is a helpful summary; many drill problems and laboratory problems are included, as well as discussion or quiz questions.

After an introductory chapter the subject is treated in the following subdivisions: Chapter 2—Beams; Chapter 3—Bond, Shear, Diagonal Tension and Anchorage; Chapter 4—Columns; Chapter 5—Continuity; Chapter 6—Buildings. Design of Beam and Girder Floors; Chapter 7—Two-Way and Flat Slab Floors; Chapter 8 — Footings. Appendixes include discussion of beam flexure and column flexure using charts, properties of power curves, building code requirements and the like. The book is well indexed.

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Industrial Instrumentation, by Donald P. Eckman. First Edition; 398 pages; size 5¾ by 8½ in.; cloth; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.; 1950; price $5.00.

This book was written primarily for the undergraduate in engineering. It is an introduction to the science of measurement which is developing into a science on its own physical foundation and has extended its scope far beyond the elementary concepts of temperature and pressure determinations. This, of course, is not news to power engineers or any other engineers in industry for they are the ones who are advancing the applications of this science.

However, it must be explained to the undergraduate student in engineering, and the principles underlying the methods of measurement employed in industrial processing and manufacturing must be reviewed. Primary emphasis is given in this book to the method rather than to the mechanism. This is proper in a book of this kind, for the mechanism also is developing and its details are learned best on the job and from the descriptive literature of the manufacturers producing it.

In most cases, it has been deemed necessary in this book to review the fundamentals of measurements. This focuses attention on the fundamentals of engineering applications and, second, induces a more analytical approach to the problems of measurement.

The subject is covered under the following chapter headings: 1—Qualities of Measurement; 2—Expansion Thermometers; 3—Thermoelectric Temperature Measurement; 4—Resistance Thermometers; 5—Radiation Temperature Measurement; 6—Methods for Composition Analysis; 7—Mechanical Measurements; 8—Measurement of Pressure and Vacuum; 9—Measurement of Head and Level; 10—Flowmetering; 11—Process Instrumentation.

An appendix contains practical tables such as those for orifice flow coefficients, thermal emf for various types of thermocouples and so on. The book is well indexed.

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Gas Producers and Blast Furnaces, by Wilhelm Gumz. First Edition; 316 pages; size 5¾ by 8¼ in.; cloth; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y.; 1950; price $7.00.

The principal feature of this book is that it includes a unique, straight-forward calculation method for blast furnaces. Many problems can be solved by calculation and this is especially true of the blast furnace. Although many reports have been made covering the technical development of gasification processes, this book meets the

One of a series of case histories from the records of Hall Laboratories, Inc.

THE CASE OF THE ADHERENT SLUDGE AND THE MISSING SILICA

All boiler feedwater contains, among other things, magnesium and calcium.

Since calcium gets into bad company and forms scale we add phosphate and get calcium phosphate sludge which is easily removed.

But if there isn't enough work to keep all the phosphate busy, it, too gets into mischief combining with magnesium to form a sticky magnesium phosphate sludge.

Magnesium however, prefers the company of silica so where magnesium-phosphate is a problem, we add silica and get easily removed magnesium silicate sludge

The problem of hard scales of calcium silicate, calcium sulphate, calcium carbonate was virtually eliminated when Hall Laboratories showed how to use phosphate for the conditioning of boiler water.

With the advent of high-pressure boilers, however, scales of sodium aluminum silicate and other complex silicates began to appear. One obvious remedy was the elimination of silica, and other constituents of these scales, from the boiler water. Effective procedures for accomplishing this were developed, and the desirability of silica-free boiler water was accepted without question.

Then another problem came to the fore—a sticky, adherent sludge in which magnesium phosphate proved to be the bad actor. What Hall Laboratories proposed was sheer heresy at the time: even if silica must be deliberately added, keep enough silica in the boiler water to precipitate all of the magnesium as magnesium silicate, removed readily by normal blowdown.

This violated all rules—but it worked. Today, silica treatment is accepted as a standard method of preventing the formation of adherent magnesium phosphate sludge.

For more than a quarter of a century Hall Laboratories has been *creating* precedents in industrial water treatment—solving new problems with full knowledge of accepted practices, but devising new techniques whenever old ideas prove to be inadequate.

Hall Laboratories is prepared to assist you in the solution of any problem involving the procurement, usage, treatment, or disposal of industrial water. For more detailed information on the nature and scope of these services, just fill out and mail the coupon.

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Hopper Discharge Mechanism	Foolproof, mechanical. No encumbering solenoid boxes or wire to alter weighing.	
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need for development of theory and calculation methods.

The real importance of this procedure is that, by proper calculation methods, a great deal of time and expense for unnecessary experiments can be saved and analysis of extreme conditions can be made without experimental means. Even readers who are not interested in making calculations themselves will profit from a better understanding of what is taking place in a gas producer or a blast furnace.

The various phases of the subject are covered in the following way: Part I on gas producers covers gasification reactions, gas composition at equilibrium and at incomplete equilibrium, other calculation methods, applications of the semigraphical method, mathematical treatment of gas-producer performance.

Part II on blast furnaces covers composition of gas, method of computation and example of computation. Part III discusses the reaction kinetics of these devices.

Several solutions are offered for the mathematical treatment of the various problems. The calculations are all worked out in terms of real and practical units, and specific quantities are related to practical operation as it is carried on today.

• • •

Brick and Tile Engineering, by Harry C. Plummer; size 6 by 9¼ in.; 392 pp; flexible binding; available from Structural Clay Products Institute, 1520 18th St., N. W., Washington 6, D. C. Price $5.00

This handbook on design is a revised edition of two books, *Brick Engineering* and *Tile Engineering*, previously published by the Institute. The volume contains the latest engineering information on clay masonry construction.

The book describes the origin, manufacture, types and properties of structural clay products and the properties and design of brick and tile walls. Chapters are devoted to discussions of brick and tile wall sections and details, specifications and properties of mortar, design of chimneys and fireplaces and data on fireproofing and furring.

General specifications for masonry construction are covered, along with bonds and patterns of brick and tile walls. A special chapter is devoted to the advantages of modular coordination in building with brick and tile.

• • •

Mechanics, by James E. Boyd and Percy W. Ott; third edition; size 6 by 9 in.; 422 pp including index and appendix; illustrated; cloth bound. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price $4.50

This third edition places emphasis on fundamental principles, examples designed to illustrate these principles, and problems to encourage the student to use logical thinking and suitable mathematical methods in their application.

Much of the material has been entirely rewritten for this edition. New problems have been added throughout the text, and these are generally more difficult than the original ones.

Several additions to the book include a new article on forced vibrations and resonance; a new chapter on moving frames of reference, which introduces the method of equivalent systems; the expansion of the treatment of virtual work; an extension of the work on systems of forces in space to cover simple space frameworks; and the addition of an article on the computation of moments in space by determinants.

• • •

Working Under Wage Stabilization; size 8½ by 11 in.; mimeographed 11 pp plus PSB regulations. Published by California Personnel Management Assn., Farm Credit Building, Berkeley 4, Calif. Price $1.00.

Pertinent current information on when wage increases can and cannot be granted without approval of the Wage Stabilization Board. Covers the text of an association paper by John R. Dille of U. S. Dept. of Labor, plus 7 pp of questions and answers asked and answered at the meeting. Also includes copies of Regulation 1 to 5 of the WSB.

• • •

The Practice of Lubrication, by T. C. Thomsen; Fourth edition; size 6 by 9 in.; 612 pp; cloth bound. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price $8.00.

This edition provides a comprehensive coverage of the origin, nature, testing, selection, application and use of all types of lubricants.

It contains lubricating information relating to advances in engine and machin-

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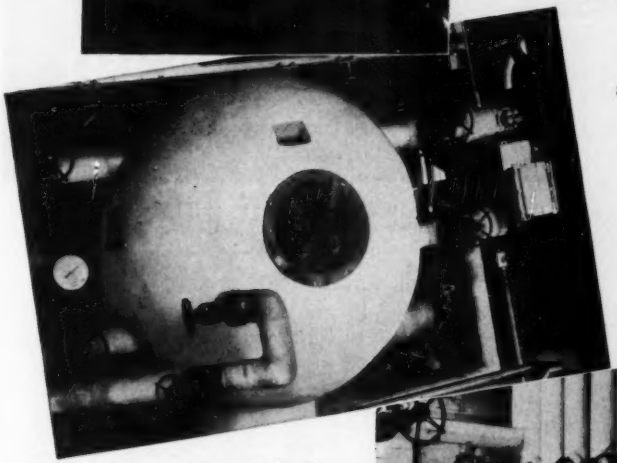

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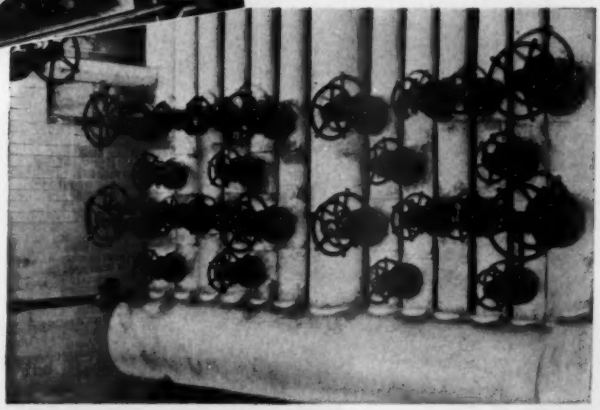

TOP: Air view of Oswego, N. Y. Station of Niagara Mohawk Power Co.

CENTER: Valves on main drum of 875,000 pounds per hour steam generator.

RIGHT: Drains from main steam, attemperator, and superheater lines employ a maze of valves.

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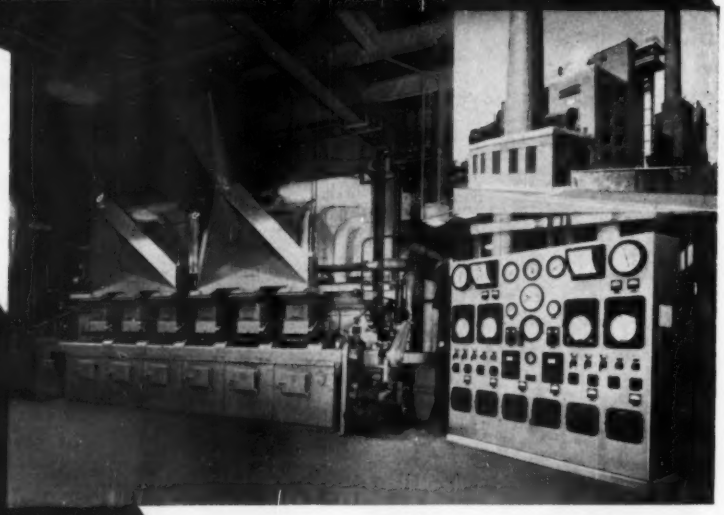

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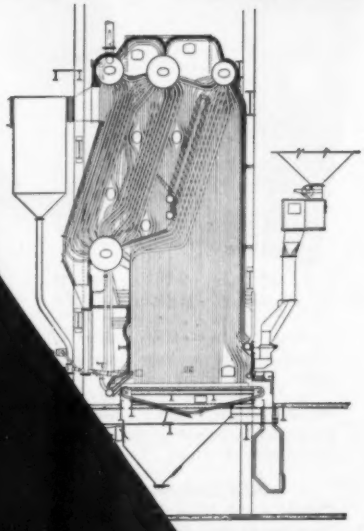

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ery construction involving higher pressures and extremes of heat and cold; facts on the distillation and refining of lubricating oils; information on the manufacture of engine-oil inhibitors and a chapter on the purposes for which they are used.

Helpful lubrication information is supplied to cover steam turbines, railway rolling stock, transmission shafting, machine tools, textile machinery, steam engines, gas engines, and the like.

The book discusses a number of typical lubrication problems, analyzes them from an engineering standpoint and points out how each problem can be solved.

• • •

Preventive Maintenance Manual; size 4 by 7½ in.; 30 pp; paper bound. Available from Professional Expediting Service, P. O. Box 224, West Hartford 7, Conn. Price $1.50.

This manual should prove helpful in serving as a guide to planning your preventive maintenance program. Suggestions are given of the steps required in initiating a preventive maintenance program.

Whether outside aid should be employed or if the program should be established by plant personnel is discussed. Other items covered are fire protection, plant painting, roofs and floors, electric motors, heating equipment, etc.

The section on scheduling gives suggested maintenance periods for various types of equipment. The reader is cautioned, however, that the best method of scheduling will come from experience.

The back section of the manual has several helpful sample forms which could be adopted in part or whole for keeping records on a PM program. The same forms cover: Motor and Control Data; Motor Parts; Machine Identification; servicing Record and Maintenance Cost; Maintenance Work Order; Hours; and so on.

• • •

Modern Air-Conditioning, Heating and Ventilating, by Willis H. Carrier, Realto E. Cherne and Walter A. Grant. Second Edition; 574 pages; illustrated; size 7¼ by 10¼ in.; cloth; published by Pitman Publishing Corp., 2 W. 45th St., New York 19, N. Y.; 1950. Price $10.00.

This book is designed by its authors to apply existing theory to actual practice in the industry. It is scarcely necessary to point out that Willis H. Carrier was, until his death recently, head of the Carrier Corp.; Mr. Grant is Director of Research of the same organization; and Mr. Cherne is a Consulting Engineer. The authors and their business associates have included much material based on data developed by Carrier Corp. and used in the schools conducted by that corporation for training technical graduates for application engineering assignments.

It is particularly true in the field of air conditioning that the art precedes the literature, as it does in every field in which there is rapid evolution. This Second Edition incorporates a revision of many sections in which progress in the art has made notable strides in the past ten years. Some of these are: Important new tables of basic factors added to Chapter 3; oil burner applications, Chapter 5; panel heating, Chapter 6; new techniques in air cleaning and purification, Chapter 11; basic data for cooling coils, Chapter 13; a functional analysis of central conditioning systems, Chapter 14; and new fundamental treatment of automatic control, Chapter 18.

The section on psychrometrics, Chapter 2, has been entirely rewritten and includes the new Carrier Psychrometric Chart. New data have been added on comfort, Chapter 2; refrigeration, Chapters 15 and 16; and the appendix. Included are many problems covering both the theoretical and practical aspects of the subject.

Obituaries

C. E. JOOS

CHARLES EMIL JOOS, vice president of the Cochrane Corp., died recently at his home, 118 Waverly rd., Wyncote, Penna., after a long illness. He was 54.

A recognized authority in the field of water treatment, he was responsible for the development of many of

Buy a Dart and you buy a union you can use *over and over* again. You get *more* years of service — more drip-proof installations — *more* for your money.

Why do Darts last longer? Primarily because they're built heavier —*better.* Seats, for instance, are spherically ground to a *true* ball joint. Thus, a Dart tightens easily—stays tight. Seats remain unmarred—true and clean for the next installation.

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Green Stack Supporting Draft Fans are practical, too. They are readily accessible for inspection and maintenance. Shafts and wheels are removable endwise without disturbing the stack or other structural members.

To those manufacturing "packaged boilers" or to those operating them with fans that don't seem to be doing the proper kind of a job or where maintenance seems too high, we offer the services of our experienced fan engineers to (1) design fans suitable for the boiler or (2) study the problem and recommend the remedy.

Our New Bulletin 168 gives details of our Stack Supporting Draft Fans. Write for a copy.

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ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

the most effective methods of conditioning water for use in high-pressure boiler plants both in this country and in Europe.

A graduate of the University of Pennsylvania, he was a member of the American Chemical Society, the American Society of Mechanical Engineers, and Manufacturers Golf and Country Club, Oreland.

He had been a member of the Cochrane organization for 25 years, joining it Jan. 1, 1926, as a chemical engineer. Earlier he had been associated with the Atlantic Refining Co., Philadelphia, and Cyrus Rice & Co., of Pittsburgh.

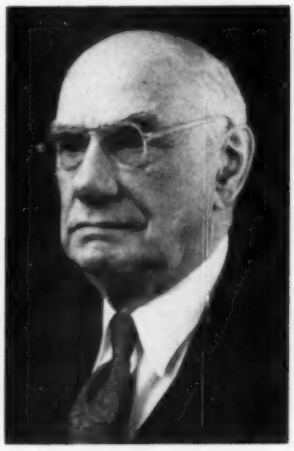
Surviving are his widow, Maybelle; a son, Robert M., and a daughter, Suzanne.

WILLIAM LAMONT ABBOTT

WILLIAM LAMONT ABBOTT, formerly chief operating engineer of Commonwealth Edison Co., Chicago, Ill., and a past president of the board of trustees of the University of Illinois, died February 20, 1951, at his home, 3500 Lake Shore Drive, Chicago, at the age of 90. He had made his home at this address since his retirement from the Edison company in 1935.

He was a pioneer in the electric light and power industry in Chicago and his career with the Edison company coincided with the growth of the business from the earliest installations in Chicago. At the time of his retirement he had completed 50 years of service in the industry.

He became chief operating engineer of the Edison company in 1899, a position which he held until his retirement. During this period the operating system he supervised grew



William Lamont Abbott

from one with 6,400 kw of capacity to one with more than 1,000,000 kw.

For 18 years he served his Alma Mater, the University of Illinois, as a trustee, including fourteen years as president of the board. The William

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Year after year, Infilco Equipment stands the test of time. The extra value of sturdy construction and realistic ratings pays off in more trouble-free, long service life. Investigate, today, the value you get from Infilco Water Conditioning Equipment. Call in the nearest Infilco Field Engineer. He's only a phone call away. There's no obligation, of course—only the obligation to yourself to investigate why Infilco Equipment is a good buy.

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Industrial Power Plant, Mississippi	*Accelator + Hydrogen Cateser®*
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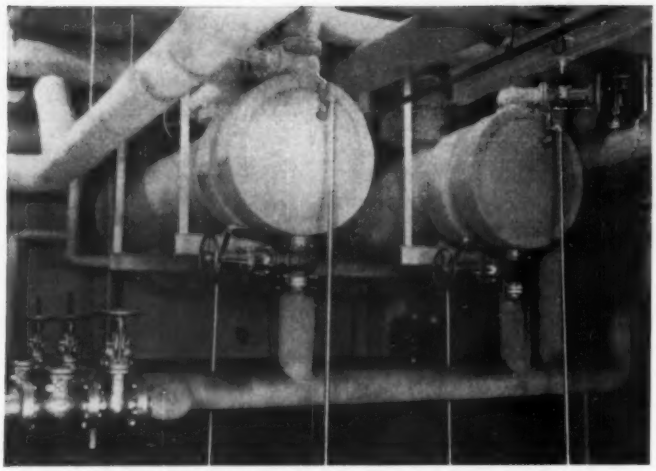

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FLOAT HEAD HEAT EXCHANGERS (Also shown in installation picture above) can be furnished with removable tube bundle and with split clamp ring construction for float head. Complete range of sizes to meet all specifications.

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Lamont Abbott Power Plant on the Champaign campus was named for him. (It was described in *Power Generation*, February, 1948). The University, in 1929, in recognition of his services to his profession and to education, conferred on him the degree of Doctor of Laws.

Mr. Abbott is survived by two daughters, Josephine, who has made her home with him; Dorothy of River Forest; Arthur W. of Downers Grove, Ill.; and Robert E. of Chicago.

Mr. Abbott was author of numerous technical papers presented before various engineering societies. He was a fellow of AIEE; fellow and past president ASME; honorary member and past president Western Society of Engineers. He received the Washington Award in 1942.

WALTER GEIST

WALTER GEIST, since May, 1942 president of Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin, died suddenly January 29 of a heart ailment. He was 56.

A native of Milwaukee, Geist was one of seven children and the son of Christian and Annette nee Haagensen Geist, who were both natives of Norway. His father was a metal patternmaker.

Geist left high school in 1909 to join Allis-Chalmers. After going to work, young Geist took evening and extension courses at the University of Wisconsin in Milwaukee.

Geist is survived by Mrs. Geist and two children, Janet Lucille Bugni and Kenneth R. Geist. Kenneth was named director of purchases of Allis-Chalmers in 1950.

RICHARD H. THOMAS

RICHARD H. THOMAS, 87, founder of Hamilton-Thomas Corp., Hamilton, died at Mercy Hospital, Hamilton, Ohio, on December 30. He was born in Allegheny, Pa., October 25, 1863. Educated in Pittsburgh, he began his business career as a mechanical commercial artist for Kelley & Jones Co., a predecessor of the Walworth Company, remaining with the firm for 15 years.

In 1898, he entered a mechanical contracting partnership with Harry Smith and specialized in air conditioning.

In 1914 the assets of the contracting firm were sold to the Iroquois Engineering Co. and Thomas founded the Economy Pumping Machinery Co., Chicago. In 1938 the firm acquired the properties of the Liberty Machine Tool Co., Hamilton, and shortly thereafter the Klipfel Co.

In 1949 Smith & Mills Shaper Co. was added to the companies then consolidated as Hamilton-Thomas Corp. In 1950, C. H. Wheeler Manufacturing Co. of Philadelphia became part of Hamilton-Thomas Corp. Thomas served as president of the firms from 1914 until 1947, when he became chairman of the board.

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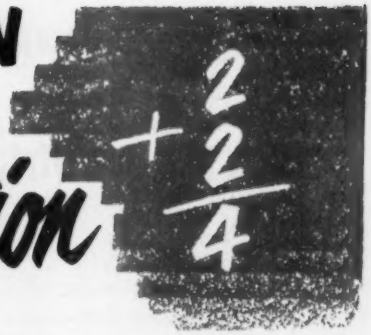
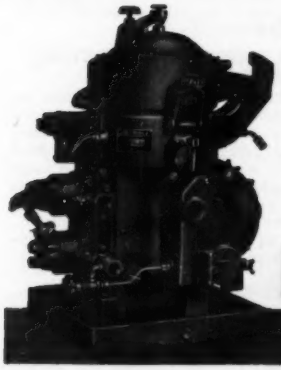


De Laval machines remove both of the impurities that contaminate turbine lubricating oil. Centrifugal force throws all dirt out of the oil and stores it out of harm's way in the bowl; it separates out any water present and continually discharges it. Water once removed cannot recontaminate the oil.

Centrifugal force alone never removes additives. Naturally inhibitors that are soluble in water will be lost with water that is removed from the lubricating oil, whether such removal is effected by centrifugals or filters. Usually very little water is present to be removed, so this cause of inhibitor reduction is inconsequential, but should a major water leak occur in the lubricating system, the centrifuge will promptly remove the water.

De Laval machines multiply the effectiveness of gravity over thousands of times! This means that quicker and more complete separation is possible by centrifugal force than by gravity methods. Moreover, De Laval machines are constant in efficiency. There are no functional parts to lose effectiveness during a run.



De Laval machines are conservatively rated. They can handle wide variations in water without loss of seal or carry-over into the oil stream.

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In just six months after W&T Chlorinators were installed, cleaning and excess steam costs were reduced from $1450 per month to $250 per month and a later survey showed an overall saving in excess steam costs of $16000 in a year.

Such savings are indicative of how your condensers may be made to operate more economically and with far less outage when W&T Engineers install chlorination to fight your slime problems.

To learn how chlorination may be profitably applied to your heat exchange equipment and to take advantage of W&T's 35 years' experience, write today.

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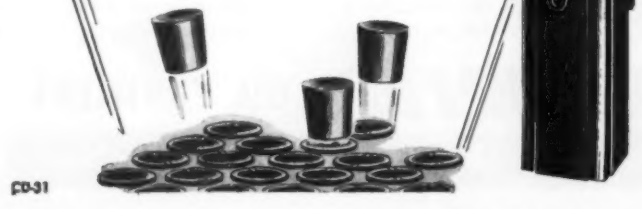

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NEWS *from* THE FIELD

NEWCOMEN MEDAL TO HARTER FOR ADVANCES IN STEAM

THE NEWCOMEN MEDAL "for achievement in the field of steam" has been awarded to Isaac Harter, chairman of the Board, The Babcock & Wilcox Tube Co., Beaver Falls, Pa., at a joint meeting of the Newcomen Society and The Franklin Institute in honor of Benjamin Franklin's birthday. This was the second time the medal had been conferred, the first being to Rear Admiral Harold G. Bowen, U.S.N., in 1944.

Among Mr. Harter's achievements in steam which led to his nomination for the Newcomen Medal were the furthering of research to remove diffused oxygen from boiler feedwater and the application of this research to boilers into which were constructed economizers built with steel tubes. This development removed the cause of corrosion which had been preventing use of steel economizer tubes. Formerly the tubes were of cast-iron which could withstand only 200 psi.

Mr. Harter also assisted in the discovery of the effect of caustic feedwater on steel, and helped find ways to prevent such caustic action. He developed steam drums made with butt strap joints caulked on the inside, thus preventing any harmful action, and eventually pioneered welded joints in boiler drums which accomplished this result and at the same time made it possible to build boilers to operate at pressures far beyond the limitation of those imposed by riveted joints. Through his efforts boilers having welded joints were first accepted by the U. S. Navy, an important factor in their later adoption by the ASME code. He also developed the method of applying X-ray to the testing of welded boiler drums and made a successful stand to have the ASME code stipulate that such joints should be X-rayed.

LOW-PRESSURE HIGH-PRESSURE TURBINE GENERATOR

UNUSUAL OPERATING CONDITIONS for an industrial steam turbine generator, to be installed in England, may be of interest to American industrial power engineers. The unit is a large condensing turbine generator recently ordered for installation in the power house of the Ford Motor Co., Ltd. at Dagenham, England, to supplement the existing generating capacity.

The turbine is designed for operation on weekdays at 195 psi initial steam pressure, but on week ends it operates at 375 psig initial pressure.

On weekdays, when the factory

Lubrication Insurance for TURBINE BEARINGS

These Bowser turbine oil conditioners are serving two 12,900 c.f.m. and two 52,000 c.f.m. turbo-blowers.

For the first six months following installation the oil in each unit was tested every thirty days. It was found to be in such continuously perfect condition that the user* considers further tests unnecessary.

*NAME ON REQUEST

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these 8 enemies of turbine performance!

1. Turbulence
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4. Heat
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6. Removal of Inhibitors
7. Fly-ash
8. Dust

Bowser turbine oil conditioners keep turbine bearings "on-the-job" in most power generating plants. Costly shutdowns are avoided and less stand-by equipment is required.

•

Write today for your copy of the new bulletin on the improved Bowser turbine oil conditioning method.

BOWSER, INC., 1351 CREIGHTON AVENUE, FORT WAYNE 2, INDIANA

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R-P&C Bar Stock Valves are an achievement of the valve makers' craft. They are precision turned . . . from carefully tested metals . . . and suitable for a wide range of pressures and temperatures . . . for meter, gauge, test, and general purposes.

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AMERICAN CHAIN & CABLE

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load is higher and existing 30,000-kw turbine generator units are running, the turbine will operate at initial steam conditions of 195 psig, 350 F, total temperature, with steam taken either from the extraction steam system or from the existing low pressure boilers. Under these conditions it is rated at 15,000 kw.

On week ends, however, when the power demand is lower, the large 30,000-kw sets will be shut down and the new turbine will supply all the power, being driven by steam at 375 psig, 840 F total temperature, taken from the 1200-psig high-pressure boilers through a reducing and desuperheating systems. Under these conditions the machine is designed for a capability of 17,600 kw continuous output.

Generation will be at 11,000 v, 3 phase, 50 cycles, feeding to the existing system. The unit has a normally air-cooled generator and direct connected exciter. These details are given in the February 1951 issue of our English contemporary, *The Steam Engineer*.

The turbine will exhaust into a conventional design condenser, with condenser circulating water at a temperature of 75 F. In addition, steam will be bled from the turbine for feed heating. An interesting feature of the feed heating system is that a live steam heater, using high-pressure steam, will be employed to raise the temperature of the feedwater to a level suitable for introduction into the high-pressure boiler system.

This interesting turbine-generator unit will be manufactured by the British Thomson-Houston Co. Ltd.

NEW URANIUM PLANT WILL REQUIRE 1,000,000 KW

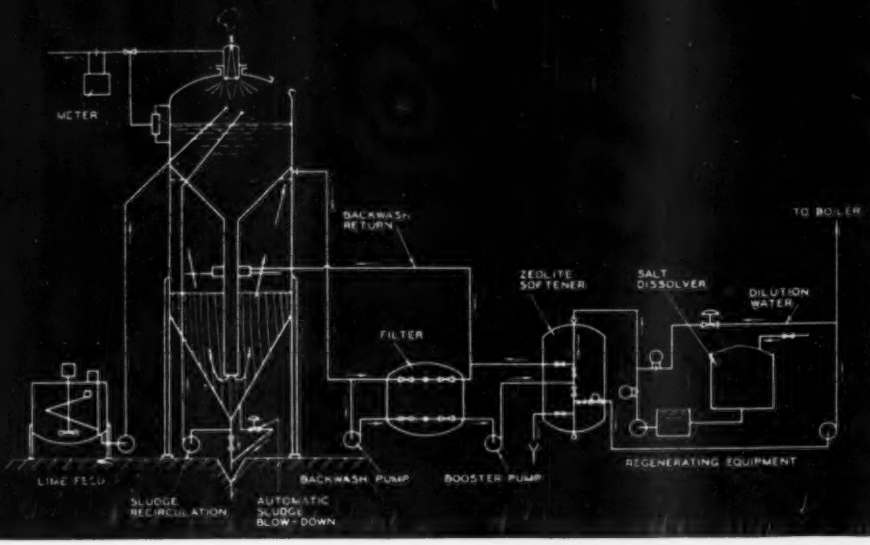
On the site formerly occupied by Kentucky Ordnance Works about 16 miles west of Paducah, Ky., the Atomic Energy Commission plans to erect a great new plant for the production of fissionable materials and especially Uranium-235 for atomic bomb and other nuclear energy uses. The plant will cost approximately $500,000,000 of which $465,000,000 will be required for two gaseous diffusion plants for extracting Uranium-235, $30,000,000 for auxiliary facilities, and $5,000,000 for administrative and storage facilities.

The atomic facilities will be operated by Carbide and Carbon Chemicals Div. of Union Carbide and Carbon Corp. which also operates the major facilities at Oak Ridge.

The power requirements for this entire project will be about 850,000 kw to 1,000,000 kw. Initial load of 350,000 kw will probably come by July 1952 and full load by the middle of 1953.

The load will be split between two organizations—one, the Tennessee Valley Authority, the other a new private power syndicate that has been organized under the name of

cochrane hot process zeolite water conditioner



1. saves chemicals
The zeolite softener uses salt instead of the more expensive soda ash and phosphates, bringing down the cost of chemicals considerably.

2. saves on capital investment The cost of adding zeolite equipment to a hot process installation is far less than the addition of an independent sedimentation tank and chemical feed for a two-stage phosphate process.

3. lower CO_2 in steam
The lower alkalinity resulting from using lime alone, plus the fact that this alkalinity is all carbonate, causes a reduction in CO_2 generated in the steam.

4. less operating attention The use of the zeolite softener with its simplicity of operation is an advantage which is enhanced by the longer periods between regenerations, due to the lower hardness of the hot process softener effluent.

5. less floor space and head room required
The addition of the zeolite equipment requires less floor space and less head room than that required for two stage phosphate equipment.

6. lower alkalinity The use of lime (or Dolomitic lime) as the sole reagent in the hot process means that the alkalinity can be reduced to about half that obtained with lime and soda ash.

7. only one chemical needed in the hot process It is generally possible to use a single reagent in the hot process, namely lime or Dolomitic lime, precipitating the bicarbonates and magnesium, leaving the remaining hardness to be removed by the more economical zeolite.

get the facts about this economical process use this coupon

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3123 n. 17th st. philadelphia 32, pa.

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in europe: recuperation thermique & epuration, paris

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Mundet 85% Magnesia Insulation provides attractive smooth finish . . . precise fit . . . maximum strength and resistance to vibration.

New heat saving efficiency is provided by Mundet Custom Molded 85% Magnesia Pipe Covering. Extra durability is built into this insulation. It is precision manufactured on the latest type of automatic equipment to insure uniform standards. It does not "powder", settle or disintegrate. It is unaffected by steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation when you specify Mundet 85% Magnesia Pipe Covering. Write for specification information and recommendations. Mundet Cork Corporation, Insulation Division, 7115 Tonnelle Avenue, North Bergen, New Jersey.

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Electric Energy, Inc. This organization has been formed by Central Illinois Public Service Co., Illinois Power Co., Kentucky Utilities Co., Middle South Utilities, Inc., and Union Electric Co. of Missouri. J. W. McAfee, president of Union Electric Co., is president of Electric Energy, Inc.

This organization will build a plant of approximately 500,000 kw capacity on the Ohio River somewhere in the vicinity of Paducah, and latest report is that it may be located at Joppa on the Illinois side of the river.

Sargent & Lundy, Chicago, is retained as consultant for power studies and for design and inspection of construction of power facilities at the site. Design of the process plant will be by Giffels and Vallet, Inc., of Detroit, and Smith, Hinchman and Grylls, Inc., of Detroit.

LARGE POWER STATION FOR INDIA

DESIGNED for a capacity of 240,000 kw, the Bokaro Power Station is now under construction about 200 miles northwest of Calcutta, India. It forms a part of the Damodar Valley Project in conjunction with a series of eight dams for hydro power, irrigation and flood control. It will be the first high-pressure steam-electric generating station in India. Smaller but comparable in conception to our own TVA, this Damodar Valley Project is part of Prime Minister Nehru's long-range plan for industrial development of India.

The new steam electric station will contain six 300,000-lb-per-hr, two-drum Combustion Engineering-Superheater steam generating units, fired with pulverized coal and operating at 950 psi, 900 F. Coal will be supplied by one of the biggest strip coal mines in the world, located three miles from the plant. This coal averages about 10,750 Btu per lb.

Design and construction of this station is by Kuljian Corp. of Philadelphia, working closely with a group of Indian engineers who have been studying operating practices in American central stations for some time. These engineers will return to Bokaro where they will work closely with the Kuljian staff and will take over the plant after a year's initial operation by the American personnel.

EVERETT S. LEE NEW EDITOR OF *GE REVIEW*

EVERETT S. LEE has been appointed editor of the *General Electric Review*, monthly engineering magazine published by the General Electric Co. Mr. Lee succeeds Edward C. Sanders, who retired recently from the company after serving since 1926 as executive editor of the publication.

Mr. Lee formerly was executive engineer of the G-E General En-

CONSOLIDATED *Maxiflow*...

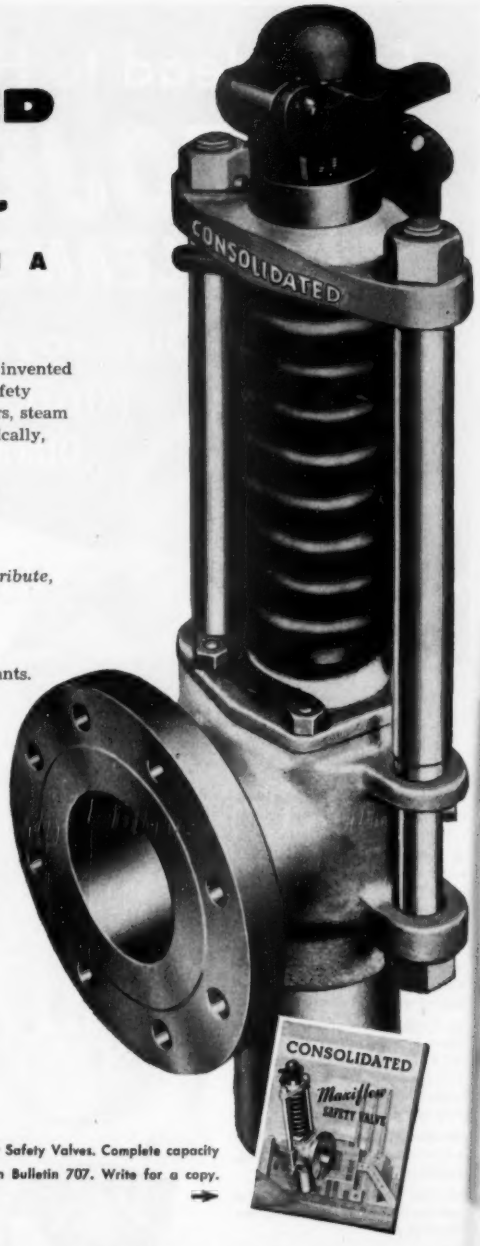
THE SAFETY VALVE WITH A 72-YEAR BACKGROUND

Only three years after Alexander Graham Bell invented the telephone in 1876, the first Consolidated Safety Valves went into service. During those 72 years, steam generating installations have changed dramatically, both in unit size and operating requirements.

Today's Consolidated *Maxiflow* Safety Valves embody greater discharge capacity, shorter blowdown and other characteristics demanded by high-pressure, high-temperature steam generating equipment. Because they are *new in all that modern engineering can contribute*, *Maxiflow* Valves set a new standard in safety and service.

When you invest in *Maxiflow*, you get safety valves with features proved in punishing laboratory tests . . . proved through years of tough service in steam generating plants. For example, the Consolidated *Maxiflow* Safety Valve . . .

1. **Permits rapid equalization of temperature differentials** because it has a thermodisc seat. Minimizes thermal stresses, prevents distortion, achieves permanent tightness.
2. **Assures constant entrance conditions for steam flow** because the forged mechanical through bushing has precision-machined surfaces. Eliminates leakage due to porous castings.
3. **Allows control of blowdown to as low as 1%.** Exclusive "micrometer" trim ring is adjustable externally—provides a simple and chatter-proof blowdown control, operable with valve under pressure.
4. **Retains the popping point** by combining proper compensation with materials that have low coefficients of expansion.



Get all the facts about Consolidated *Maxiflow* Safety Valves. Complete capacity tables, description and features are shown in Bulletin 707. Write for a copy. →

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** BRIDGEPORT 2, CONNECTICUT

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL AND 'MICROSEN' ELECTRICAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES. BUILDERS OF 'SHAW-BOX' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

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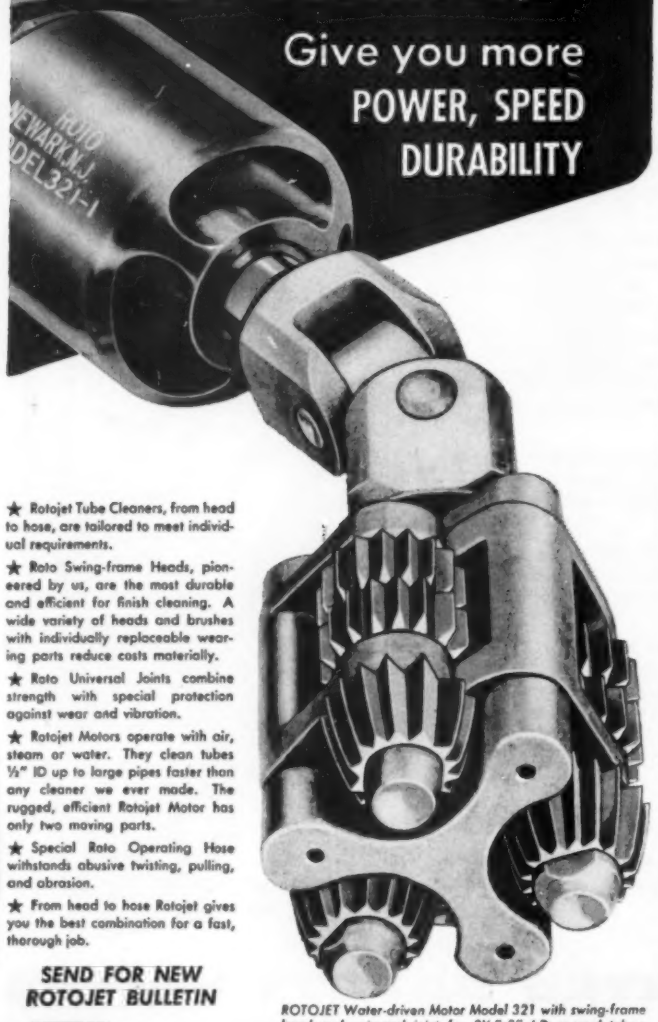
ROTOJET

TUBE CLEANERS

Give you more

POWER, SPEED

DURABILITY



★ Rotojet Tube Cleaners, from head to hose, are tailored to meet individual requirements.

★ Roto Swing-frame Heads, pioneered by us, are the most durable and efficient for finish cleaning. A wide variety of heads and brushes with individually replaceable wearing parts reduce costs materially.

★ Roto Universal Joints combine strength with special protection against wear and vibration.

★ Rotojet Motors operate with air, steam or water. They clean tubes ½" ID up to large pipes faster than any cleaner we ever made. The rugged, efficient Rotojet Motor has only two moving parts.

★ Special Roto Operating Hose withstands abusive twisting, pulling, and abrasion.

★ From head to hose Rotojet gives you the best combination for a fast, thorough job.

SEND FOR NEW ROTOJET BULLETIN

ROTOJET Water-driven Motor Model 321 with swing-frame head and universal joint for 2½"-3" I.D. curved tubes

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue Newark 1, N. J.

gineering Laboratory in Schenectady and is a past president of the AIEE. In addition to his editorial duties, he will continue his active work in professional engineering and engineering educational circles.

A native of Chicago, Mr. Lee was graduated from the University of Illinois in 1913 with a B.S. degree in electrical engineering and received an M.S. degree in electrical engineering from Union College in 1915.

Following his graduation from the University of Illinois, Mr. Lee joined General Electric in Schenectady as a study engineer on the Test Course. The next fall he became an instructor at Union College, Schenectady, and was in charge of the electrical engineering laboratory there.

During World War I, as a first lieutenant, he was officer in charge of machine gunnery of the U. S. Army School of Military Aeronautics, University of Illinois. In 1919, he returned to GE as division engineer on instruments and measurements in the General Engineering Laboratory, and has been with the company since.

In 1928, he was made assistant engineer of that laboratory, and three years later was made engineer. In 1945, the General Engineering Laboratory and the Consulting Laboratory were combined to form the General Engineering and Consulting Laboratory, with Mr. Lee as executive engineer. The laboratory recently was renamed General Engineering Laboratory.

Mr. Lee, who is recognized as an expert on electrical measurements, is author of numerous technical papers on instruments and methods of electrical measurement.

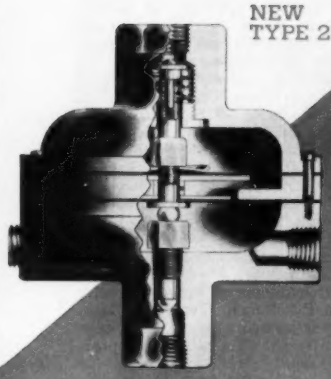
A fellow of the AIEE, of which he was president in 1948-49, Mr. Lee has served on 19 national committees for that organization. As AIEE representative, he served on the National Research Council, the Engineers Council for Professional Development, of which he was chairman from 1943 to 1945, the United Engineering Trustees, Inc.

In addition, he is a fellow of ASME, senior member of IRE, and a member of ASEE and many other technical societies.

PURCHASE OF the R-S Products Corp. of Philadelphia by S. Morgan Smith Co. of York, Pa., was announced recently by Beauchamp E. Smith, president.

Mr. Smith announced that the present management of R-S Products Corp., W. E. Borbonus, president, and D. W. Hopkins, executive vice president, will be retained along with the present five-man board of directors. The S. Morgan Smith Co. will provide two additional members of the R-S board, Burwell B. Smith, vice president, and Duncan D. McArthur, secretary, respectively, of

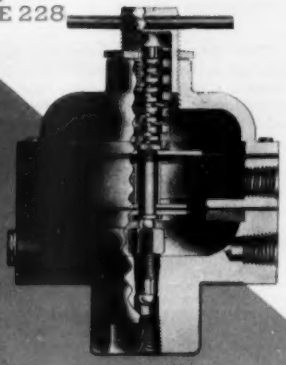
NEW
TYPE 227



A delayed action, fixed ratio relay. For use with series-operating diaphragm control valves in "split ranges". Permits full valve travel with primary control pressure changes as low as 2 or 3 pounds.

NEW
TYPE 228

Reverse action relay delivers maximum pressure output at minimum input or vice versa. No modification in either pilot or valve hook-up necessary. Or install in bypass to achieve reversal of valve closure in relation to pilot action if required occasionally.

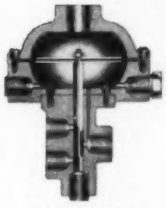


Get greater speed of action ...Install BS&B "Climax" Relays

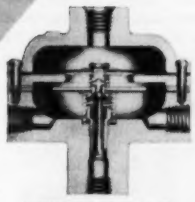
• BS&B "Climax" Relays serve as primary regulator valves to step up the action through the control of supply medium to the control valve.

The wide BS&B "Climax" line provides a variety of functions ... one-to-one, fixed ratio, variable ratio, delayed or reverse action. They may be used to load diaphragms or pistons with liquid operating medium while the control instrument loads the relay with gas. Booster action is also possible, to enable small capacity controls to handle larger duties.

Write today for the latest illustrated catalog Section 109, complete with descriptions, performance figures, installation data.



TYPE 209
1 to 1 Ratio

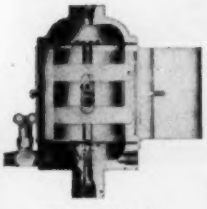


TYPE 217-4A
Fixed Ratio

BLACK, SIVALLS & BRYSON, INC.
Climax Controls Division
Adv. Dept. Room 53R 7502 East 12th St. Kansas City 3, Mo.

BS&B

"Climax"
RELAY REGULATORS



TYPE 224
Variable Ratio

the parent company. There will be no change in the operation of the Philadelphia concern.

Two VETERAN employees have been elected to the Board of Directors of Hagan Corp., Pittsburgh, and its subsidiaries, Hall Laboratories, Inc., and Calgon, Inc. R. R. Donaldson joined the Hagan organization in 1919, one year after it was founded, as a service engineer. He was advanced to chief engineer in 1945 and was elected vice-president in charge of engineering in 1948. Dr. Everett P. Partridge joined Hall Laboratories, Inc., in 1935 as research director. He was elected director of Hall Laboratories in April 1950, succeeding Dr. R. E. Hall. J. M. Hopwood is chairman of the Board of Directors. Other members include T. A. Peebles, Dr. Hall, D. J. Erikson, president of the corporation; E. M. Chaney, D. C. McKim, G. A. Binkley and W. W. Hopwood.

ROBIN S. KERSH, formerly manager of central station sales for the Westinghouse Electric Corp., has been named manager of the company's Steam Division at South Philadelphia, Pa.

In his new position, Mr. Kersh will direct the activities of manufacturing steam turbines, gears, steam condensers, stokers, blowers, and ship propulsion machinery.

Mr. Kersh was graduated from Mississippi State College in 1929 with a Bachelor of Science degree in electrical engineering. He joined Westinghouse that same year as a member of the Graduate Student Training Course, and later was assigned to the industrial sales department. In 1942 Mr. Kersh was named manager of the company's Houston, Texas, office and remained there until 1947, when he was appointed manager of industrial sales at East Pittsburgh. Two years later he was promoted to manager of central station sales, from which position he comes to his new duties.

CONOFLOW CORP., Phiadelphia, announces the appointment of J. R. Simpson and Company, 600 South Michigan Avenue, Chicago, as Conoflow representatives.

WILLIAM A. ROBERTS, executive vice president in charge of the tractor division for Allis-Chalmers Manufacturing Co. since 1947, was elected president of Allis-Chalmers today in a special meeting of the board of directors.

Roberts succeeds the late Walter Geist, who served as president from May, 1942, until his death on January 29. Geist died of a heart ailment at the age of 56. (See obituaries, this issue.)

ROBERT H. OWENS has been elected president and general manager of Roots-Connersville Blower Corp., succeeding John Avery who died unexpectedly on January 13.

EXTENSIVE CHANGES in the sales organization due to retirements, promotions and additions have been announced by Dearborn Chemical Co., Chicago. Two new managers for Dearborn's Eastern Division have been appointed; C. S. White as head of the Water Treatment Department replacing S. H. Opdyke who was retired January 1, and Howard E. Johnston, manager of NO-OX-ID sales, replacing C. A. Remsen who passed away in January. White was formerly sales representative in the Iowa territory. Both men make their headquarters in New York. Opdyke and Remsen had been with the company 38 and 36 years respectively.

COCHRANE CORP., Philadelphia, Pa., announces the appointment of S. B. Applebaum as manager of its Water Treatment Division. Applebaum, who has specialized in water conditioning for more than 35 years, joined Cochrane in 1949, since which time

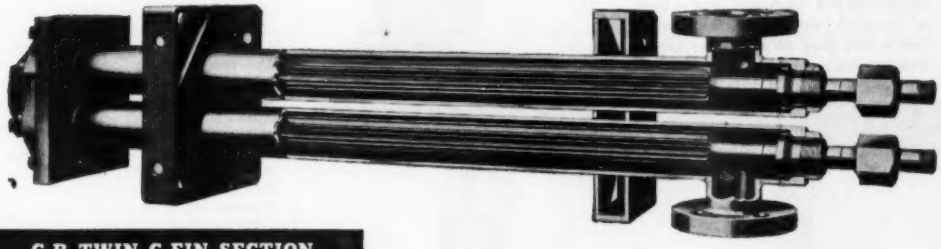
Builders Visible Flow Chlorinizers are designed to *simplify* plant operation — not to complicate it. Any competent mechanic with a knowledge of the proper methods of handling chlorine can easily master the operation and maintenance of Builders Chlorinizers. Specially trained personnel are not required to operate or service these chlorine gas feeders. The utmost safety and dependability are assured when Builders Chlorinizers handle your chlorination jobs. For Bulletins and complete information, address Builders-Providence, Inc. (Division of Builders Iron Foundry), 385 Harris Ave., Providence 1, R. I.

BUILDERS makes a complete line of flow meters and controllers for liquids, steam, air, gas, and dry materials . . . mechanical and differential . . . including The Venturi Meter and Chlorinizers (chlorine gas feeders).

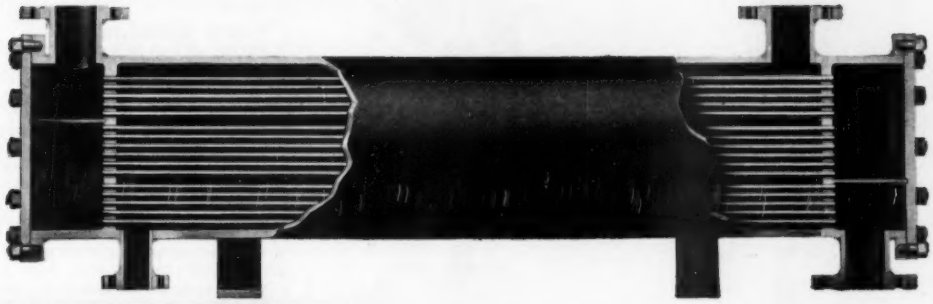
Installation in Sewage Plant, Medina, Pa.

B-I-F INDUSTRIES **BUILDERS-PROVIDENCE** BUILDERS

Take Your Choice for
FUEL OIL HEATING



G-R TWIN G-FIN SECTION



G-R TYPE B TUBULAR HEATER

G-R offers you the choice of two different designs of fuel oil heater. Both designs are of long-proven heating effectiveness and dependability. Both designs have readily accessible tube interiors and are easy to keep clean. Both designs are of sturdy construction and are lastingly secure against leakage.

If your requirements are for the heating of large quantities of oil, you want the compact, easily handled G-R Type B Heater.

Where your requirements are for moderate or small quantities, with great capacity flexibility and a minimum of spare equipment, you want the G-R Twin G-Fin Section.

Write for full information on each of these units, and for advice as to the most suitable type of heater for your particular plant conditions.

THE GRISCOM-RUSSELL CO., 285 MADISON AVENUE, NEW YORK 17, N. Y.

GR-227

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

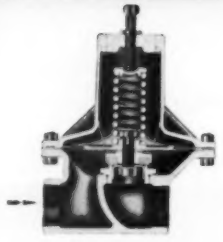
STEP UP YOUR PROCESSING EFFICIENCY BY CLOSER REGULATION OF EXCESS PRESSURES

The Foster line of Automatic Pressure Relief Valves has been developed to provide the close regulation of excess pressures necessary for efficient processing. They protect the equipment from damage due to overpressure without loss of fluids in process in closed systems.

Each type has been designed to meet specific service conditions, and is built of materials best suited to the process. That's why they do their jobs better, and require less maintenance.

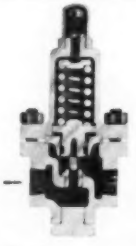
Here are 4 typical Relief Valves in the Foster line of more than 20 standard types

(FOSTER R-1)
The Foster Type R-1 is especially suitable for steam, oil and heavy liquids. Direct acting, diaphragm actuated for sensitive regulation.



(FOSTER R-3)
The Foster Type R-3 is built for general service on normally low pressures. Direct acting, with large diaphragm area for quick response to small changes in pressure.

(FOSTER R-4)
The Foster Type R-4 is designed primarily for high pressure steam service where practically instantaneous relief is required with minimum build-up. Internal pilot-operated.



(FOSTER R-22)
The Foster Type R-22 is used to relieve high pressures in hydraulic systems where extremely close regulation is not a requirement. Direct acting, piston actuated.

FOSTER ENGINEERING

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . CUSHION CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SIRENS . . . SAFETY VALVES . . . FLOW TUBES

he has been manager of the Cold Process section of the Water Treatment Division. He was founder and is vice-president of Liquid Conditioning Corp., now a subsidiary of the Cochrane Corp.

PATRICK J. PATTON has been appointed Milwaukee Manager for the Commercial Sales Division of the De Laval Steam Turbine Co. of Trenton, New Jersey. He will handle the sales of De Laval turbines, pumps and blowers in Wisconsin, with headquarters at 1932 North 117th Street, Wauwatosa, Wisconsin.

LADISH Co., Cudahy, Wis., has announced the appointment of E. O. Dixon as Vice President in Charge of Research and Metallurgy, and T. L. Swansen as Vice President in Charge of Manufacturing. Mr. Dixon has been with the Ladish Co. for over 20 years. He actively participates in the SAE, ASTM, ASM, and SESA and is chairman of several committees. Mr. Swansen, an active member of the SAE, joined the Ladish Co. in 1947 as Chief Engineer. He rose to the position of General Superintendent in 1949. In his new position, Mr. Swansen will have charge of the manufacturing facilities.

POWER GENERATION FROM WOOD WASTE

(Continued from page 61)

to the boiler room. Also when the steam is low it is frequently necessary to have two men in front of each boiler firing frantically to bring the pressure back up. This cost will not be considered.

The second type of factory to be discussed is the same as the above with the exception that it buys all necessary power and uses wood waste to generate steam for process and heating. It is reasonable to assume that it will not be necessary to burn any coal so this will be left out. Average power during the eight hour working day will be 1250 kw. For one year with holidays excluded this will amount to 2,600,000 kwhr. From four to six pm and on Saturday morning the load will generally be about 500 kw. For one year this will amount to 380,000 kwhr. The average load at night and on week ends should approximate 25 kw. For one year this will amount to about 146,-900 kwhr. The over-all total would then be 3,126,900 kwhr. In most areas of the country this power would cost as little as 1 cent a kilowatt hour. The amount spent yearly for power would then be $31,-269,00.

There are some savings in comparison with the first installation where a portion of the power was generated. They are about as follows:

$4500.00 yearly for an engine operator.

$4000.00 yearly for wood sold dur-

ing the summer months.

$1500.00 yearly for engine room maintenance.

Total $10,000.00 Difference $21,269.00 — 20,200 = $1069.00.

It is apparent that there is actually very little difference where an obsolete power plant is concerned whether the company purchases all of its power or elects to make a part of it. The first cost of the generating equipment for making part of the power enters into the picture and generally it would be cheaper to buy the power as many companies do. It is at this point we come to a definite dividing line—with some engineers saying that it pays to buy the power and others saying that it should be generated with the waste fuel. It is my opinion that it always pays to generate steam and electric power with the waste fuel provided ALL POWER IS GENERATED except a small amount for starting the power plant and for operating the power plant at night.

The first approach to a well designed power plant for the furniture factory must take into consideration the maximum possible heating demand with sufficient allowance for future plant expansion. A single boiler of 900 bhp capable of continuous rating of 200 per cent which would generate a maximum of 60,000 pounds of steam per hour would be desirable. There is no point in having two or three small boilers of poor design with attendant maintenance when a single unit can do the necessary work. This boiler should be able to operate at about 78 per cent efficiency under full load conditions. It should have automatic combustion control, and feedwater control, and set up to operate under the supervision of a single operator. This alone can save as much as $10,000.00 a year. A hog should be installed in the factory and all refuse pulverized and blown to a storage bin connected to the boiler. The waste fuel would then be automatically fired according to the load demand. This type of installation should be installed regardless of whether or not the electric power is generated or bought. If the factory elects to sell its surplus wood then a maximum amount can be sold if the steam requirements are efficiently fulfilled.

The waste fuel value of 663,000,000 is now capable of much more work. 663,000,000 x 78% = 517,000,000 Btu. At 200 psi, 522,000 lb of steam per day can be generated. It was stated earlier that the factory would require 1250 kw of power per hr. If this power was generated by an engine generator exhausting at 10 psi back pressure with a water rate of 35 lb then the engine would require 43,750 lb of steam per hr. This amounts to 350,000 lb per eight hour day; 242,000 lb would be available for additional power generation or for heating at night. With the engine

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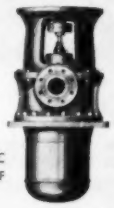
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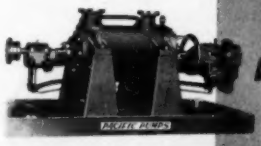
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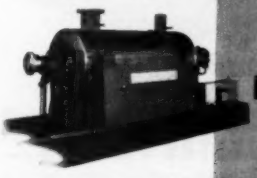
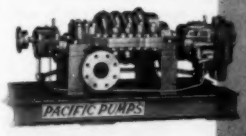

PACIFIC TYPE IBF



PACIFIC TYPE JBF

TYPE	QUANTITY	Pounds Per Hour	Degrees Temp.	Pounds Pressure
WBF	11 Pumps	47,700	259F	710
ABF	3 Pumps	230,000	281F	1110
	3 Pumps	358,120	220F	1300
	4 Pumps	350,000	300	1000
IBF	3 Pumps	423,000	310F	1825
	3 Pumps	495,000	306F	1615
	2 Pumps	450,000	310	1800
	6 Pumps	405,000	305	1750
	3 Pumps	450,000	310	1825
JBF	2 Pumps	163,600	260F	490
	1 Pump	117,500	250F	775
	3 Pumps	300,000	240	1000

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running, over 40,000 lb of exhaust steam would be available for process. During the heating season most of this steam would be utilized and returned to the boiler as condensate. In the summertime the steam not needed would be exhausted to the atmosphere. It is obvious that any furniture factory, if it so elects, can become a self-sustaining plant with the exception that power would have to be purchased at night and on week ends which would be about 150 kva. This power on a demand basis would cost $300 monthly or $3600 annually.

The boiler plant is a necessity and if the plant wishes to eliminate the purchase of coal for auxiliary firing during the wintertime it will be necessary to set up a reasonably efficient plant wherein storage of refuse for night firing is possible. An engine-generator set of 1250-kw capacity complete with switchgear and and necessary appurtenances including building and overhead crane would cost approximately $125,000. Approximate saving would be $17,000 per year. The electric generating equipment would then be paid for in less than eight years. This equipment with proper care should easily last thirty years.

If the furniture factory is in a position to sell power a turbine can be installed instead of the steam engine at less cost, depending on available condenser cooling water. By selling power it will take much less time to off-set the original cost of the power plant.

The curves in Figs. 1 and 2 may be taken as representative of the standard factory discussed in this article and will adequately guide an engineer attempting to determine whether or not a factory should generate or buy power. In order to draw these curves the following figures were used:

Weight of wood waste as fired.... .....3 lb per board foot
Wood waste by weight.... .....65 per cent
Heating value of wood waste per pound.....8500 Btu
Boiler efficiency .....78 per cent
Steam pressure .....200 psi
Exhaust pressure .....10 psi
Engine water rate.... .....34 lb per steam per kwhr
Average water rate including power house auxiliaries, traps, etc.. ....37.5 lb per steam per kwhr

The following problem is presented to show how the curves may be used: A furniture factory is being built or re-designed so that it is capable of cutting and processing 30,000 board feet of lumber per eight hour day. With references to Fig. 1, horizontal line A is drawn as shown to where it intersects curve X. A vertical line B is then drawn from this point and we find that 850 kilowatts per hour will be required to run the factory.

Another horizontal line C is now drawn as shown in Fig. 2 to a point of intersection on curve Y. Vertical line D is drawn from this point and we find that 255,000 lb of steam will be required for power generation per eight hour day. Continuing the horizontal line C until it intersects curve Z, we again draw a vertical line E and we find that the wood waste from a cutting of 30,000 board feet is capable of furnishing 392,000 lb of steam. The difference (392,000—255,000 = 137,000 lb of steam) can be used for additional power generation, or heating, or whatever disposal is best suited to the actual plant under consideration.

POWER PLANT LABORATORY

(Continued from page 66)

grade of laboratory truck approximately 40 in. by 25 in. by 35 in. equipped with rubber tires should be available.

Stool—An adjustable metal stool should be provided for use at the balance table.

Routine Chemical Analyses

WATER ANALYSES

Any chemical treatment of boiler feedwater requires some simple methods of control. Overdosing with chemicals is uneconomical and may cause serious operating troubles,

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MOLDED LIP PACKING
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A truly high-quality piston packing for steam, gas and oil under pressures up to 300 lbs. p.s.i., and temperatures to 425°F. Made of tightly woven absestos, carefully finished, and lubricated with graphite.

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For centrifugal or rotating pumps handling hot or cold water, steam, brine, oils and various acids. Produced from long-fibre asbestos yarns, square plaited, with each strand thoroughly graphited. Will not carbonize or harden. All sizes.

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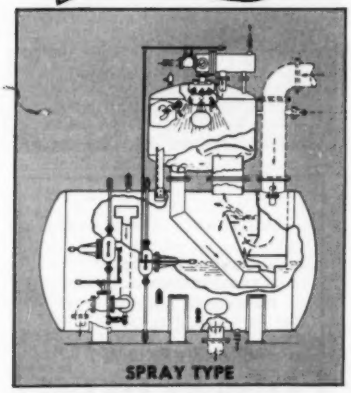
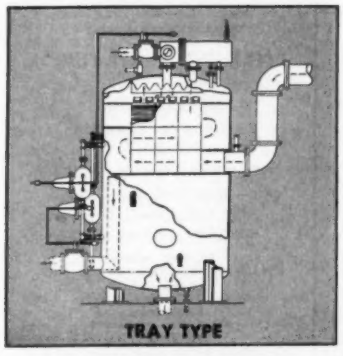
With 100% make-up water, your unit produces zero oxygen, and this office and the owners are very well pleased with the performance of the unit.



SPRAY TYPE



TRAY TYPE

Here is part of a letter which we recently received from a midwestern engineering firm concerning the performance of a Graver Deaerating Heater installation at a large public institution of which they were in charge.

This spontaneous testimonial is typical of the reports we continuously receive from users of Graver Deaerating Heaters. Whether the units are Spray or Tray type . . . operating on steady or fluctuating loads . . . or with small or large amount of boiler feed make-up . . . a Graver installation can be depended upon to produce zero oxygen and to eliminate carbon dioxide.

Graver's 40 years of experience and pioneering leadership in water conditioning are at your service to solve your water treating problem. Whatever your needs may be, you can be sure of modern, highly effective equipment based on the latest proven developments in water conditioning processes. Your request for authoritative advice and complete information will not involve the slightest obligation on your part.

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What it is —

Filtration with Sorbo-Cel is a simple, low-cost method of removing emulsified oil from water. In plants using steam generating equipment, it is proving an especially effective and economical means of obtaining oil-free condensate for boiler feed. It also provides a practical solution to other oil-contaminated water problems, such as the water used in pumps, condensers, cooling systems, moving driers, etc.

How it works —

The method is similar to that used in other conventional industrial filtration operations. A small amount of Sorbo-Cel (a specially processed diatomaceous silica powder), is added to the water to be filtered. This is then pumped through a pressure filter where the oil globules are adsorbed by the specially treated Sorbo-Cel particles. Both are retained on the filter screen, the filtered water alone passing through. Any type of pressure filter having a metal screen and capable of operation at a pressure differential of 30 psi or more may be used.

What its advantages are —

Sorbo-Cel filtration is fast, economical and efficient. It assures virtually complete removal of oil, as well as suspended solids such as rust, scale, clay, etc. Large volumes of water are filtered in a relatively short time, yet total costs (including both material and operation) range from only 1¢ to 3¢ per 1000 gallons of water filtered.

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while use of insufficient chemicals permits scale to form and gives unsatisfactory and costly results. A simple method of analytical control should, therefore, be used in checking the boiler water treatment each day.

In order to have complete information regarding the condition of the raw or makeup supply, the condensate, feedwater and boiler salines, all or several of the following analyses should be made.

Phenolphthalein Alkalinity as $CaCO_3$
Methyl Orange Alkalinity as $CaCO_3$
Hydroxide Alkalinity as $CaCO_3$
Free Carbon Dioxide as CO_2
Hydrogen Ion Concentration as pH
Total Hardness as $CaCO_3$
Sodium Chloride as NaCl
Soluble Phosphate as PO_4
Sodium Sulphite as Na_2SO_3
Sodium Sulphate as Na_2SO_4
Sodium Nitrate as $NaNO_3$
Iron as Fe
Silica as SiO_2
Total Solids

From the analyses it can be determined whether the waters are satisfactory to meet all the conditions necessary for proper feedwater treatment. Too high an alkalinity will cause foaming or priming. Traces of hardness will lay down scale on metal surfaces of the boiler. High sodium chloride will result in carryover, while deficiency of sulphate offers no protection against caustic embrittlement. A low hydrogen ion concentration will cause metal corrosion, and deficiency of sodium sulphate permits dissolved oxygen corrosion.

Generally, it is not possible to specifically state the tests that should be made on water samples for controlling treatment since these tests depend largely upon the type of treatment employed.

The majority of these tests are performed by titration employing standardized reagents. There are several satisfactory methods for determining the hydrogen ion concentration of water samples. Selection of this equipment depends upon personal preference, but we recommend that both electrometric and colorimetric equipment be selected. In most cases some form of internal phosphate treatment is employed in boiler water conditioning, hence it is necessary to determine the residual phosphate, either colorimetrically by means of a phosphate comparator or by the use of an electrophotometer.

The determination of total solids by the gravimetric method is a long time-consuming and tedious operation in that the sample must be properly protected from contamination by atmospheric dust and accurate weighing must be made on an analytical balance. This method is still used in a large number of well-equipped laboratories. However, it is not necessary to determine the total solids by this method daily. It could, instead, be done weekly and a factor calculated from the gravi-

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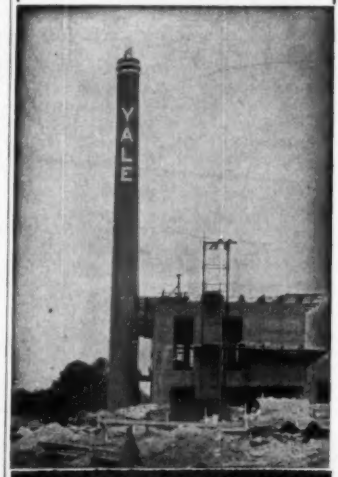

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metric results for daily use. An alternative method calls for the use of suitable equipment for measuring the conductivity of the sample. From the conductivity measurement, usually expressed in micromhos, a suitable conversion factor is used from which the total dissolved solids are obtained. This latter method will not include any suspended material because as such it will not have any effect upon the conductivity measurement. There may be some changes in regard to the tests mentioned above, but a definite plan of control should be established and samples should be properly collected and tested daily.

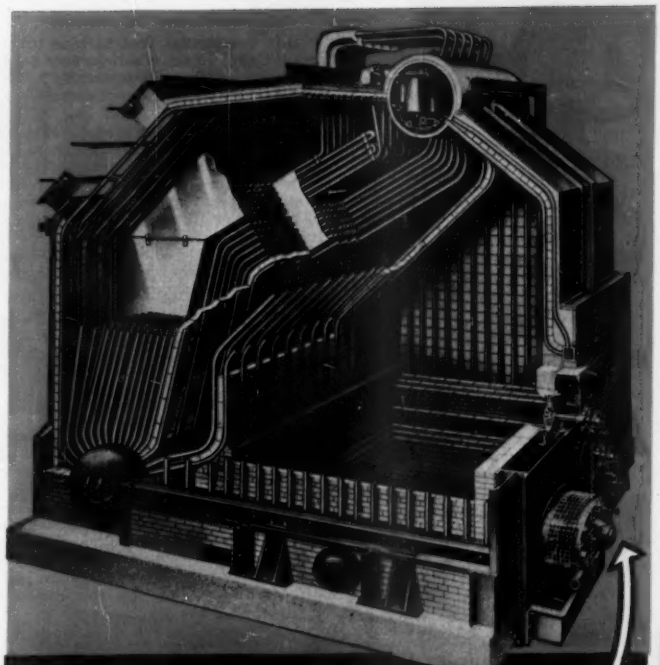
There are other tests that should be made on samples of boiler feedwater, condensate, steam and evaporator vapor. The most generally accepted tests for determining steam or evaporator vapor purity include the hydrogen ion concentration and conductivity measurement. The concentrated liquid in the evaporator must also be analyzed periodically. The tests on evaporator salines are similar to those made upon boiler water samples, with the exception that in most cases the evaporator feedwater is not subjected to chemical treatment but is filtered and softened water and supplementary treatment is not required. Condensate from the turbo-generators should be analyzed periodically to detect as soon as possible if there is any infiltration of cooling water. This is important not only from the standpoint of condenser efficiency but also to eliminate any effect the raw water would have on the water in the boiler.

The deaerating heater effluent should be tested for its dissolved oxygen content, hence suitable equipment must be furnished for this purpose. We believe that most plant operators realize the importance of efficient deaeration and for this reason this phase of the work is not being discussed in detail.

Selection of the analytical determinations to be made depends on the type of boiler, as well as the pressure and temperature at which it is operated. For instance, high concentrations of silica in the boiler water can be responsible for deposits, either in the boiler or on turbine blades. Most plant laboratories include this determination in their routine work so that proper control can be exercised.

No attempt has been made to recommend specific analytical methods but it is suggested that all water analyses be made in accordance with standard methods of the American Public Health Association and the American Society for Testing Materials.

It is impossible to furnish any information concerning the tests to be made on treated water, that is, prior to evaporation, because it was not mentioned what type of treatment, if any, would be employed.



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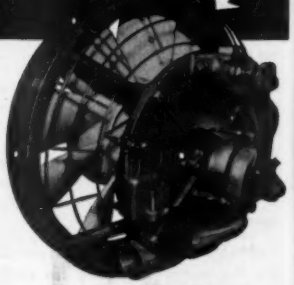
Besides furnishing forced draft with precise control, the Wing Turbine Blower contributes to the cost-saving features of the B & W Integral Furnace Boiler, illustrated above, by saving valuable floor space, avoiding duct work and large space requirements. It is also quiet and efficient in operation.



A copy of Wing Bulletin No. SW-50 on Wing Blowers and Turbines will be sent on request.

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1. Full control obtained by 2½ turns of single handwheel. Operates rapidly and easily.

2. TWO large identical basket strainers, either of which can be removed for cleaning without interruption to the flow.

3. Rotary valve motion eliminates dirty or clogged seats as the discs are always in contact with the seats.

4. Operating mechanism is on the downstream side of the strainer, not in the path of flow and in contact with clean strained liquid only.

5. Designed for minimum pressure drop and low maintenance (only one stuffing box).

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Lubricating Oil Analyses

It is essential that turbine lubricating oil retain a satisfactory quality under the circumstances of its use, that the oil does not contain corrosive substances, and that it will not deposit materials which clog the oil lines. The periodic review of the characteristics of lubricating oil which is in service and the examination of new supplies by the laboratory helps to protect the machinery of production.

There are a number of tests that can be made on lubricating oil, but the most important are:

Color	Interfacial Tension Number
Acidity	Steam Emulsion Number
Neutralization Number	Water
Viscosity	Carbon Residue

These tests are accepted by most persons familiar with this type of work but there is some difference of opinion regarding the merits of certain of them. It would be advisable to discuss this matter with the lubricating engineer furnishing the oil so that any plant tests that are made can be properly correlated with those made by the company furnishing the oil.

Estimate for Furnishing and Equipping Power Plant Laboratory

Interior construction of room	$ 3,300.00
Laboratory furniture	5,000.00
Major laboratory equipment for water analyses	2,500.00
Major laboratory equipment for oil analyses	1,000.00
Laboratory glassware and supplies	700.00
Total estimated cost of furnishing and equipping laboratory	$12,500.00

NARROWS POWER PLANT

(Continued from page 72)

a General Electric Co. machine, designed for a throttle pressure of 275 psig, 625 F under a back pressure of 1 in. Hg. The rated capacity of the alternator is 12,500 kva, 11,000 v, single phase, 25 cycles, 1500 rpm. The machine is provided with a direct connected exciter of 75 kw capacity and generating 250 v direct current.

The generator is wound as a three-phase machine to supply three-phase *auxiliary* power while the single-phase traction load is taken from generator phase one and phase two.

Circulating water for the condenser is taken from the New River. The water is diverted from the river by an intake and it flows to the turbine room, a distance of 200 ft, through a tunnel where it connects with another tunnel below the basement floor from which the condensers take their supply. A short distance from the intersection of the two tunnels, on the outside of the turbine room, a small forbay and concrete structure was built to accommodate two or more Link Belt vertical motor driven traveling screens equipped with water jets. The existing screens were obsolete and practically worn out and were replaced by two Link Belt Model 45 vertical traveling screens with trays 120 in. wide and equipped with water jets.

Conclusion

The completion of this work, the installation of the new boiler and turbine and the rehabilitation of the old equipment has improved the over-all performance of the Narrows Plant and has made it possible to handle the greatly increased demands on it with no trouble and also has corrected the fly ash nuisance. The coal burned is Bituminous with a heat value of around 14,200 Btu per lb. On test, the boiler efficiency, when delivering 200,000 lb of steam per hr, was slightly over 85 per cent.

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Now we are expanding our activities in the boiler manufacturing field and must increase our engineering and drafting force. We need boiler draftsmen and designers for permanent employment—experienced in heavy and light plate work, structural steel, pressure vessels, piping and similar work.

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Minimum Span, Oversize Casing Studs
Proof against cutting between stages depends on uniform pressure on gasket. On Warren TH Pumps, extra heavy bolting is especially close to channel rings and bolts are spaced and oversized to provide uniform pressure and lock flanges together for maximum strength. (Inner bolts 1¾", outer bolts 1½")

Locked Channel and Case Rings . . .
Inter-stage seals or channel rings are not only wide to reduce by-passing between stages to minimum, but to make it possible to place casing bolts close to rings for maximum and uniform pressure on gasket. Double flange in lower half and single flange in upper half assures secure locking of channal and casing rings.

Genuine Kingsbury Thrust Bearing
Made by Kingsbury Machine Works, not modified type of other make. Oil cooled, heavy duty, duplex ball thrust bearing available and practical for discharge pressures 800 p. s. i. and lower.

Trouble-Free Solid Discharge Nozzle
Discharge nozzle is flared and extra heavy, with studs, instead of the conventional flanged type nozzle, thus eliminating danger of breakage.

Extra Heavy Casing Flanges . . . .
To provide freedom from warping, casing flanges are not only extra heavy but each bolting point is backed up with heavy boss, providing highest possible strength.

"Undercover" Facts—

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There are many other important factors designed to provide a sound investment over the years. Evaluate the benefits and contact Warren on your next high pressure boiler feed job. Write for Bulletin 244 giving further details.

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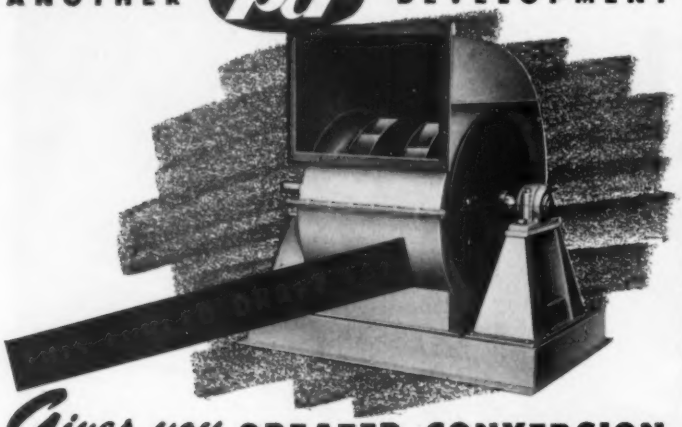

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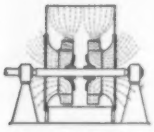
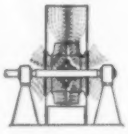


How P-D split wheel assists diffusion—aids distribution throughout the fan.

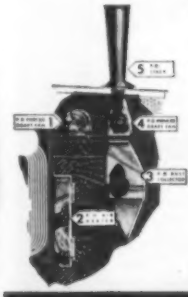


Conventional double wheel with common disc produces concentration, results in poor diffusion.

Performance ratings of the Prat-Daniel F-D Fan are established according to the Standard Test Codes adopted by N.A.F.M. and the A.S.H.V.E.

Design characteristics provide unusually high conversion of Velocity Pressure to Static Pressure. This is accomplished by streamlined inlet cones that are larger in proportion to the wheel than are usually found in forced draft fans. The unusual depth of the cones provide a wider housing than would customarily be used, increasing the space available for diffusion. Precisely fashioned backward curved blades provide a nearly perfect aerodynamic flow across both leading and trailing edges. Double wheel fans are spaced apart to permit four way diffusion of air, further contributing to this conversion. Peak efficiency and horsepower curves fall well within normal fan selection range, offering the optimum in maximum efficiency and non-overloading characteristics.

These are all carefully researched features that have made the Prat-Daniel F-D Fan a highly efficient apparatus. Check these features before you decide on your next fan. Write for catalog No. 300 today.



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(Continued from page 50)

sizes and wall thicknesses of welding fittings in other metals. Grinnell Co., Inc.

248 **How to Choose and Use Air Traps** —Bulletin 202, 4 pp, describes a line of air traps, covering their selection and installation for automatic drainage of moisture from compressed air intercoolers, aftercoolers, receivers, separators, drip points. Prices included. Armstrong Machine Works.

249 **Safety Valve Engineering Data**—How company's safety valve works and its important operating advantages are explained in Bulletin 707, 4 pp. Includes dimensions on flanged and welded inlet valve types, tables on superheat correction factor, capacities in pounds of saturated steam per hour. Manning, Maxwell & Moore, Inc.

250 **Flanges for Severe Service** — This 4-pp bulletin describes and illustrates a flange specially developed for services involving severe abrasion and corrosives, and for use in suction and discharge service. Also covers a flexible rubber pipe for abrasive or corrosive material, and an acid- and corrosion-resistant duct. Goodall Rubber Co.

251 **To Get at those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels and makes them readily accessible. Prices given. Babbitt Steam Specialty Co.

252 **Strainers and Separators** — Bulletin R-46-50A is a 16-pp catalog on T-type strainers, suction strainers, multi-flow and receiver separators. Contains dimensions, weights, prices. Shows how several types have been redesigned for increased efficiency. Dimensions, service pressure ratings. American District Steam Co.

FUEL OILS, LUBRICANTS

253 **Diesels, Their Fuels and Lubricants** —This 48-pp book offers a well organized and attractive presentation of practical information on diesel engines, covering their history and economics as well as their design characteristics and operating principles. Classification of diesels according to speed is explained. Other chapters cover injection systems, combustion chambers, lubricating systems, and deisel oil purification and filtration. Includes a discussion of fuel and lubricating oil required. Sinclair Refining Co.

254 **Fuel Oil Treatment** — By text and sketches, this folder points out undesirable conditions in the storing, pumping, heating and burning of industrial fuel oil and the correction of these conditions by company's fuel oil treatment. E. F. Drew & Co., Inc.

255 **The Answers on Turbine Oil**—This 2-pp booklet answers several questions power engineers ask about turbine oils, including: What causes deposits of sludge? What causes acidity increase? What causes corrosion in turbines? Standard Oil Co. (Indiana).

256 **Grease Application Devices**—The development and use of many types of lubricating devices are discussed in an excellent article in Vol. 36, No. 9 of Lubrication, company's technical publication on lubricants. Covers the pressure gun, spring type grease cups and several types of power driven grease lubricators, explaining such points as the judicious use of pressure measured lubrication, pumpability characteristics of lubricants. The Texas Co.

257 **Air Compressor Lubrication Manual** —Valuable information on air compressor maintenance is contained in this 40-pp illustrated book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and their applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, and safety precautions. Cities Service Oil Co.

COAL, ASH HANDLING

258 **Spreader Stoker** — Bulletin 890, 40 pp, describes a spreader stoker with overthrow rotor designed to provide uniform fuel distribution. Discusses advantages of this type of stoker, including its

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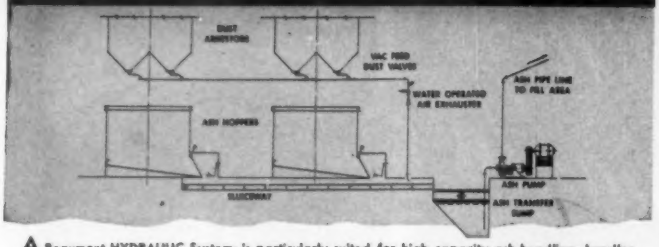

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efficiency in the burning of many grades of coal and in handling of fluctuating loads. Power-operated and hand-operated dumping grates and stationary grates are shown. Detroit Stoker Co.

259 **Coal Handling Equipment** — Modern equipment for the storage and handling of coal and ash is presented in 24-pp Bulletin 300. Illustrated, covers concrete and tile silos, cylindrical steel tanks, suspended steel bunkers. Gifford-Wood Co.

260 **Spreader Stoker Selection** — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

261 **Spreader Stoker Data**—This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

262 **Coal Scale** — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. How beam system, electrical components and linkages are protected from exposure to coal dust, explained and illustrated. Typical installations are pictured. Richardson Scale Co.

263 **Small Crushers**—"For Better Testing and Small Scale Reduction" 6 pp, describes practical applications of company's small crushers, grinders, and shredders of reduction of coal, by-products, chemicals, clays and many other products. Typical installations are diagrammed and explained. Special attention is devoted to construction features and functional advantages of the different mills. American Pulverizer Co.

264 **Ash Handling Systems**—This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions and diagrams of arrangements included. Beaumont Birch Co.

CONDENSERS

265 **Condensers** — Bulletin 441-C, 28-pp, covers in detail every phase of manufacturer's line of condensers—their simplicity of design, accessibility, construction features. Assemblies, parts, principles of operation are pictured. Condenser Service & Engineering Co.

266 **Steam Condensers with Reserve Flow** — Eight-pp Catalog 410-1 describes a "self-cleaning" reverse-flow condenser for power plant service, designed to virtually eliminate cleaning down time and, in the case of divided water box condensers, eliminate operation at partial load. C. H. Wheeler Mfg. Co.

267 **Ejector Instruction Manual**—Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and aftercondensers, isolating valves, drain traps, steam and back pressures, steam nozzles, condensing water, raw water cooling, recirculation and removal of condensate. Fully illustrated. Foster Wheeler Corp.

PUMPS, COMPRESSORS, ENGINES

268 **For Many Pumping Jobs**—The Series A313A of company's IMO pumps, designed for low cost standardized, quantity production, is described in illustrated Bulletin L313A-B, 8 pp. This is a general service screw-type rotary pump for petroleum products and other light or viscous fluids as required for rotary and steam atomizing oil burners, oil transfer, lubrication, hydraulic systems and similar services. De Laval Steam Turbine Co.

269 **Compressor Selection Chart** — Here's a chart, based on normal applications handling air with atmospheric intake pressure. It simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute and shows recommended compressor bore and stroke in inches. Worthington Pump and Machinery Corp.

270 **For Controlled Volume Pumping**—Sixteen-pp Bulletin 450 presents company's air-cylinder powered chemical pumps for controlled volume pumping at constant speeds, at proportional rates, at high pressures, and for other applications. Illustrated with photos, sectional drawings. Shows design details; typical feed systems available; auxiliary equipment. Also includes air consumption and capacity-pressure tables. Milton Roy Co.

271 **Boiler Feed Pumps**—Bulletin 109, 16 pp, illustrated in color, describes in detail centrifugal pumps for boiler feed service. Explains and pictures construction and major parts, explaining in detail the floating seal incorporated. Capacity data is provided, also vapor pressure tables. Pacific Pumps, Inc.

272 **Pulsation-Free Compressor Piping**—Illustrated Bulletin PDS-8501, 4 pp, describes company's pulsation dampening piping system. Tells how this piping compares in first cost to other piping, but affords higher operating efficiency, other advantages. Explains pulsation phenomena in gas compression systems and how dampening principle is applied. The Fluor Corp., Ltd.

273 **Centrifugal, Reciprocating Pumps**—This is a helpful collection of bulletins covering many types of centrifugal and reciprocating pumps for a wide range of services. Includes data on single-stage and multi-stage pumps, close-coupled pumps, high pressure pumps, pumps especially suited for handling erosive and corrosive liquids and others. Warren Steam Pump Co., Inc.

FANS, BLOWERS

274 **Mechanical Draft Fans**—An extensive line of mechanical draft fans for both forced and induced draft service is described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, also includes performance curves showing efficiencies of various types of fans. Gives details of construction features, drive arrangements, mounting methods. The Green Fuel Economizer Co., Inc.

275 **Axial Flow Blowers**—In this 6-pp illustrated bulletin are described axial flow blowers of both turbine-driven and motor-driven types. Gives capacity and dimensional data, operating range and specifications on both types. Also describes draft inducers. L. J. Wing Mfg. Co.

TURBINES

276 **Turbine Catalog Collection**—This is a valuable collection of bulletins covering a complete description of solid wheel turbines. They feature cross section drawings of typical units for both moderate and high steam pressure conditions. Includes data on speed increasing and reduction gears. The Terry Steam Turbine Co.

277 **Velocity Stage Turbines** — Catalog 82-19R, 8 pp, features turbines for mechanical drives designed to operate under all inlet steam conditions up to 600 psig and 750 F. Gives specifications, dimensions. De Laval Steam Turbine Co.

PACKINGS

278 **Pump Packings** — Packings for use on reciprocating and centrifugal pumps are illustrated by photo and described in this 4-pp folder. It covers packings for practically all services and includes recommendations. Johns-Manville.

279 **Teflon Packings**—Form AD143 offers 8 pp of information on packings and gasketing material made of Teflon, giving properties, typical and special applications. Styles and types are pictured, construction described, sizes given. Includes chapter on toxicology of Teflon at extremely high temperatures. The Garlock Packing Co.

280 **Manual on Packings**—Containing 84 pp of helpful engineering and ordering information, Catalog 40 covers packings for practically every service. Illustrates each type, gives sizes, construction and application details. Includes packaging recommendation charts, conversion tables. The Belmont Packing & Rubber Co.

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281 **Fly Ash Elimination** — Power engineers will find this 30-pp booklet outstanding among material on this sub-

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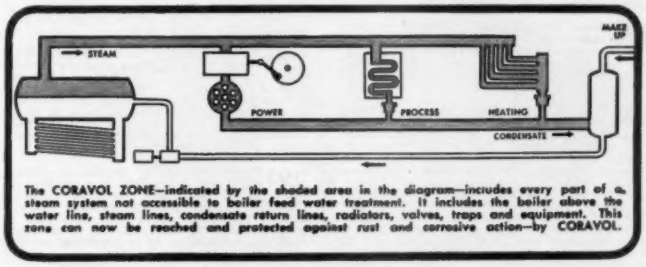

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282 **Dust Collecting Efficiency**—How the higher and narrower inlet utilized in company's tubular dust collector contributes to more efficient dust collecting is explained in this illustrated bulletin. Prat-Daniel Corp.

HEATERS, HEATING

283 **Water Heaters**—Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-pass, four-pass and six-pass designs, with tube bundles removable for inspection. Davis Engineering Corp.

284 **Fan Heater Bulletin** — Here's a 2-pp illustrated bulletin (No. 109) on a new high pressure steam fan heater designed for complete utilization of both sensible and latent heat of high pressure steam. Niagara Blower Co.

285 **Heat Exchangers** — Bulletin 11.0.080 describes air cooled heat exchangers for condensing or cooling of steam or process vapors, natural gas, jacket water, lubricating oil, quenching baths. Equipment Div., J. F. Pritchard & Co.

286 **Tubular Heat Exchangers** — Bulletin 916, 32 pp, describes tubular heaters, coolers, condensers and heat exchangers and their features. The various types of shells, tube bundles, stationary heads and floating heads are explained. Includes tables showing characteristics of tubing, the thermal resistance of tubes and pipes of many different metals and alloys, and the specific gravity and pounds per gallon corresponding to degrees Baume and API. Also presents charts of specific heats of midcontinent crudes and for solving MDT formula with correction factors. The Griscom-Russell Co.

METALS

287 **Engineering Data on Inconel** — In addition to providing information on Inconel, 24-pp Bulletin T-7 also presents details on composition, mechanical properties, physical constants of Inconel X. The International Nickel Co., Inc.

288 **Steels for Hot Spots** — This is an 88-pp manual filled with information on steels for elevated temperature service. Includes a discussion of the general principles of high temperature behavior of ferrous materials and the factors influencing their behavior; a data section replete with tabular and graphical material covering mechanical property values of 21 steels. United States Steel.

OTHER EQUIPMENT

289 **The ABC of CO_2**—An interesting, readable text covering the role of carbon dioxide in combustion efficiency. 16-pp illustrated Bulletin 452 discusses theoretical vs practical perfection of combustion and tells how to determine percentage of CO_2 in flue gases. CO_2 as a basis for figuring heat and fuel losses is also described and method of determining such losses explained. Includes scales of total heat losses of various types of coal, fuel oils and gas, also case histories of savings realized through increased CO_2 percentage. The Hays Corp.

290 **Cleaning Industrial Equipment**—This bulletin on manufacturer's service for cleaning steam generating, heat exchange and other industrial equipment includes information on pipe line cleaning and water well acidizing. Treats in detail methods used to remove incrustations from internal surfaces economically with minimum of downtime. Dowell Inc.

291 **Fundamentals of Hydraulics**—Technical Bulletin B-4 is a newly revised 44-pp guidebook covering essential information on hydraulic systems, maintenance trouble-shooting and selection of proper fluids. Besides offering well-organized reference data to engineering personnel, this book is suggested as a training manual for maintenance supervisors, operators and apprentices. It features specially prepared phantom and cutaway drawings illustrating functions of basic types of valves, pumps, hydraulic motors, torque converters. Shows function of each component part. Sun Oil Co.

292 **Transmission Belting** — Catalog M-9022, 28 pp, gives detailed design, engineering and performance data on transmission belting. Tables on belt speeds, arc of contact, friction, horsepower correction, and service factors are included. United States Rubber Co.

293 **Industrial Insulation Catalog**—Mineral insulations for practically every purpose are covered in this 20-pp illustrated catalog. Describes insulating cements for both high and low temperatures, high temperature block insulation, block finishes, felts, blanket insulation, pipe coverings, loose wool, weatherproofing and stack paints. Tells what each class of insulation is for, what it can be expected to do, how it's applied, how it's packaged and, in most cases, how much it costs. Discusses requirements of a good insulation. Forty-Eight Insulations, Inc.

294 **Industrial Dry Coolers** — Illustrated Bulletin DC-50, 12 pp, presents company's line of dry cooling equipment for small, "in-between" and heavy-duty cooling jobs and includes three new models. Two of these are small "portable" units and the third a medium-size unit. Although designed primarily for cooling engine jacket water, they can also be used for cooling natural gas, lube oil, fluids of refining stages. Includes dimensions and weights, also rating tables for cooling water. The Marley Co., Inc.

295 **Index to Information** — Compiled to help power engineers obtain literature wanted on chemical proportioning equipment, volumetric and gravimetric feeders, and recording, indicating and control instruments, 4-pp Bulletin BIF-1 describes briefly 36 available bulletins covering this equipment. BIF Industries.

296 **Packaged Dryers** — Bulletin 16.0.080 presents company's Hydryers for air, gas or liquid drying, explaining their design and operation. Describes in detail five different types of units. Illustrated by photos. J. F. Pritchard & Co.

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• In the aviation industry, Hughes Aircraft Company went from 36% to 76%; Boeing Aircraft enrolled 10,000 new names before Christmas.

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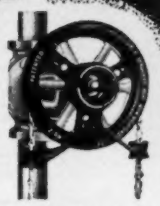


Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

A range of 10 ADJUSTABLE sizes fits all valve wheels, with rising or non-rising stems, from 2 to 30 inches in diameter.

PREVENTS ACCIDENTS! No more climbing to operate overhead valves.

PREVENTS WASTE! Positive control, immediate response.

EASY CONTROL! Easier than direct manual operation.

SAVES MONEY! Avoids accidents, permits piping short-cuts, saves piping costs.

ADJUSTABLE . . . fits all valve wheels

CUTS COSTS . . . simplifies pipe layouts

CUTS ACCIDENTS . . eliminates climbing

● **Here's easy, convenient, instant control of overhead, out-of-reach valves — right from the floor! Four simple, quickly-assembled parts and the valve handwheel is ready to operate.**

Distributors in principal cities, or send for Catalog Folder PE-2 and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Massachusetts

New *VERSENE test kit determines total water hardness in less than *TWO MINUTES***

Now, with this new Versene* water hardness testing kit you can determine the hardness of your own boiler, process or tap water as easy as ABC—in less than 2 minutes. Anyone who can tell red from blue can make this scientific versenate test and be accurate within one grain of hardness per gallon.

Handy, sturdy, pocket-size plastic kit contains 3 vials of chemicals and one combination measuring and mixing vial. More than 50 separate tests can be made, depending on water hardness. Complete instructions. Refills available. Order The New Versene* Water Hardness Testing Kit today. $5.00 Postpaid. Send Checks or M.O. No C.O.D.'s. Money Back Guarantee. Write Dept. H.

We also manufacture and supply Inhibited Indicator and Di Sodium Versenate (the di sodium salt of ethylene diamine tetra-acetic acid). These are the reagents used in the Versenate (Schwartzenbach) Method for the determination of Water Hardness.

DI SODIUM VERSENATE
50 g. $2.00 100 g. $3.00 500 g. $10.00

INHIBITED INDICATOR
100 cc $1.00 250 cc $2.00 500 cc $3.00 1000 cc $5.00

BERSWORTH CHEMICAL COMPANY
FRAMINGHAM, MASSACHUSETTS
*Trade Mark

HELPFUL BULLETINS

(Continued from page 38)

quiet operation, reduced dust hazard and other advantages, and describing its construction and design features. Includes specifications, over-all dimensions, photos of parts. Beaumont Birch Co.

129 **Proportioning and Weighing**—Bulletin 0550 presents an over-all view of company's control panels and automatic scales of the pre-weighing type, illustrating and describing briefly some typical models. Special features of the line are listed, and some typical installations illustrated. Richardson Scale Co.

SOOT AND DUST CONTROL

130 **Rotary Soot Blower Head**—Although new in the stationary field, the soot blower head described in Bulletin 486, 4 pp, has been used in many marine installations for better boiler cleaning. The reasons why are explained in terms of lower cleaning costs, higher efficiency and reduced maintenance. Vulcan Soot Blower Div., Continental Foundry & Machine Co.

131 **The Efficiency of Decantation**—The decantation principle as applied in dust control systems and how it separates high carbon content particles from fly ash for re-injection as fuel is discussed in illustrated Catalog 260D. A typical installation is diagrammed and efficiency curves included. Long run economy and other advantages listed. The Thermix Corp., Prat-Daniel Corp.

PUMPS, COMPRESSORS

132 **Screw Pumps**—Revised Bulletin S-204 illustrates and describes screw pumps in capacities to 3000 gpm, pressures to 200 psi on low viscosity liquids which flow into pump inlet. Explains basic construction and design details. Data provided cover both horizontal and vertical types, giving specifications, dimensions, application information. Includes selection chart. Warren Steam Pump Co., Inc.

133 **What's New on Air Compressor Drives**—Up-to-date information on motor drives for all types of large air compressors is supplied in E-M Synchronizer No. 32. Included in this issue is application and selection data on both motors and controls for a variety of compressor types and sizes. Fully illustrated, this 24-pp house organ contains tables, charts and graphs for matching motor characteristics to compressor requirements. Also provided is a technical discussion of Pr, "synchronizing power," methods of motor control for compressor installations and an article on the use of compressed air in the glass industry. Electric Machinery Mfg. Co.

LUBRICATION

134 **Oil for Precision Mechanisms**—The special properties of company's instrument and bearing oils for the lubrication of small precision mechanisms and instruments, and how they help solve problems frequently encountered in this type of lubrication are discussed in Form A.D.-5493, an illustrated folder. Gulf Oil Corp., Gulf Refining Co.

135 **Hydraulic Grease Fittings**—This new 16-pp 1951 Industrial Catalog illustrates and describes company's line of hydraulic grease fittings, couplers, swivel couplers, control handle for boosting grease pressures to 12,000 lb, and top oiler for upper cylinder lubrication. Includes helpful interchange chart on fittings. Universal Lubricating Systems, Inc.

OTHER EQUIPMENT

136 **Standardized Cranes** — Twenty-pp Catalog 218 illustrates, describes and gives outline dimensions for company's standardized production built Shaw Box Load Lifter cranes ranging from small push type crane bridges to large capacity hand operated cranes and also cranes with electrically operated hoists for stand-by service. Photos show equipment, some installations. Manning, Maxwell & Moore, Inc.

137 **Tape Is a Tool**—The efficient usage of industrial adhesive tape—widely used for splicing cables, sealing openings in turbines and engines, color coding of supply lines—is discussed in this 20-pp handbook. Tells features of various types of backings and calendered and spread adhesive masses, gives tips on storage, handling, and use of dispensers. Twelve taping problems from bundling to the taping of inside curves are explained and illustrated. An 8-pp insert folder gives a picture story of how tape is manufactured. Bauer & Black Div., The Kendall Co.

138 **Table on Tolerances**—Data Card 115C is the latest edition of company's table on tolerances for round seamless carbon and alloy steel mechanical tubing, giving permissible variations in diameter and wall thickness. It refers to cold-drawn-unannealed and finished-annealed tubing in sizes to 7⅞ in. OD and to hot-finished tubing to 9⅝ in. OD. The Babcock & Wilcox Tube Co.

139 **Dimensional Data Card**—Dimensions on welding fittings and flanges otherwise found only by searching through catalogs and tables, are condensed and reproduced on two sides of this 8½ by 11 in. varnished card. One side covers company's welding fittings, showing wall thicknesses and essential dimensions for all types for pipe sizes from ½ through 30 in. The other side covers forged steel flanges, giving essential dimensions and bolting data for pipe sizes from ½ through 24 in. Taylor Forge & Pipe Works.

COAL PIPELINE PROPOSED FOR OHIO

PROPOSAL FOR a pipline to convey coal in Ohio has recently been made; and legislation to establish it as a public utility has been introduced into the Ohio State Legislature.

It will be remembered that similar action is being sought for the use of a long conveyor belt line in that same region for transporting coal and iron ore. (See *E. P. Power Generation*, March 1949, page 7).

It is announced that Pittsburgh Consolidation Coal Co. will construct a pilot pipeline near the site of its Georgetown surface mining operation. It is reported that the line will be 17,000 ft long and that it will be in operation this summer.

To deliver coal through the line, the coal would be ground to small size and mixed with water. This mixture would be forced through the line by additional water supplied by high pressure pumps built alongside the line.

Both the pipeline and the beltline are intended as a means of transporting coal from southern Ohio to the Cleveland area. The beltline, might also move iron ore southward.

HELP WANTED

MECHANICAL ENGINEERS

Qualified to prepare engineering studies, detailed mechanical designs, specifications and estimates for industrial and public utility steam power plants.

Salaried position commensurate with experience; location in Boston. In reply please state educational qualifications, work experience, and salary desired. Present employers will not be contacted before personal interview.

Stone & Webster
ENGINEERING CORPORATION
49 FEDERAL STREET, BOSTON 7, MASS.

CLASSIFIED ADVERTISING

EQUIPMENT FOR SALE

HEATING PLANT EQUIPMENT FOR SALE

The University of Oregon has the following equipment for sale:

One Babcock & Wilcox Boiler, Single Cross Drum, Box Header, 220 4" tubes 20 feet long; installed 1937; operating pressure 160 lbs.; State of Oregon inspection #2016-37; equipped with 2-cell Dutch Oven setting; steam gauge; water column; Diamond soot blower; blow-off valve; Stets feed water regulator; all valves to complete the equipment including feed valves and non-return valves; supporting steel; grates; dampers; and fire and ashpit doors.

One Keeler Boiler, Cross Drum, Box Header, 128 4" tubes, 20 feet long, 150 H.P. rating. This boiler has been condemned by the State of Oregon and is not in operation. Includes following accessories: Steam pressure gauge; water column; feed water regulator, flow type; blow-down valves and feed water and non-return valves; supporting steel; grates; dampers; fire and ashpit doors.

Two Keeler Boilers, Longitudinal Drum, Box Header, 128 4" tubes each, 20 feet long; State of Oregon inspection #5808 and #5809. Installed 1923. These boilers are set in a battery setting. Equipment includes pressure gauges; water columns; flow type feed water regulators; blow-down valves; feed water line valves; non-return valves; safety valves. Also included are the supporting steel; grates; dampers; fire and ashpit doors.

One Induced Draft Fan—B. F. Sturtevant, mfr. "Turbo-Vane," Size 1010, Design No. 2, with reduction gear manufactured by Western Gear Works, Seattle; and framed for Moore Steam Turbine drive. Steam turbine not included.

Four 9 H.P. Westinghouse Induction Motors, Type CS, 220-440 Volt, 3 ph, 60 cyc, 1070 RPM.

Four Sumner Prescott Enclosed Reduction Gears.

Three Cochrane Steam Flowmeters, recording type.

One Foxboro CO_2 Recorder.

One Boiler Feed Pump — Worthington, mfr. Type 2U1. Pump has frame for Moore Steam Turbine mounting. Steam turbine not included.

One Fuel Oil Pump—Gardner, mfr., Horizontal Duplex, 4x4x3; mounted in battery on single base; with oil heater complete with gauges, valves and pressure regulators.

One Draft Controller—A. W. Cash, mfr., including steam governing valves.

Four Oil Burners—2 Schutte-Koerting, steam atomizing; 2 Duplex, steam atomizing.

Two Feed Water Pumps, Horizontal Duplex, 6x10x4½; manufactured by Dean Bros.

One Vacuum Pump, 8x12x12, manufactured by National Steam Pump Co.

One Vacuum Pump, 12x16x8, manufactured by Dean Bros.

One Steam Pump, Horizontal Duplex, 10x6x12, manufactured by Fairbanks-Morse.

One Fuel Oil Heater, including temperature controls.

One Cinder Removal Screen, including motor and reduction gear drive.

Two Boiler Tube Cleaning Equipment, water turbine driven for 4" tubes.

Hogged Fuel Conveyors and Elevators, including approximately 750 lineal feet of conveyor chain; five metal feed chutes with chain operated gates; one bucket type belt conveyor, elevator, complete with sprockets and sheaves.

Boiler Breeching from damper boxes to the stack, including fly-ash spray system.

For complete listing and bid forms write or call I. I. Wright, Superintendent of Physical Plant, University of Oregon, Eugene, Oregon. Only written bids on all or any part of the above list will be considered. Bids will be opened on April 20, 1951, at 2:00 P.M.

CHAPMAN

Steel Valves

Score on all 3 Points

1

CHAPMAN STEEL VALVES have the high precision ratings of custom-made valves — but the economy of production-line manufacture.

2

CHAPMAN STEEL VALVES are made exclusively from quality-controlled steels developed and produced in Chapman's own foundries under control of Chapman's own outstanding metallurgists.

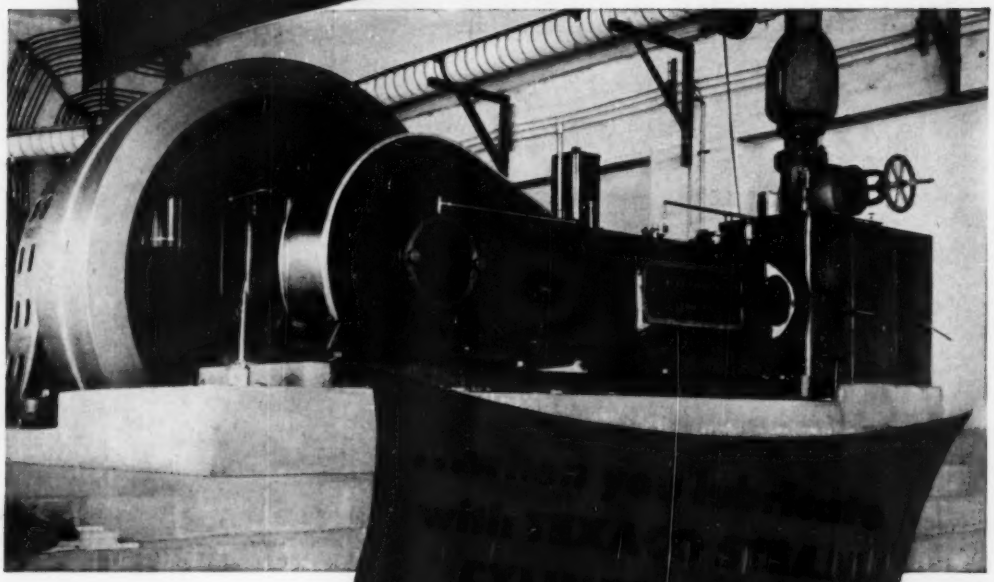
3

CHAPMAN STEEL VALVES are designed to equal or surpass — A.S.A. and A.P.I. Standards in all pressures and temperature ranges.

Be sure to see Chapman first whenever you need steel valves — gate, globe, angle or check. As a result of Chapman's long years of research and experience, they are tops in every respect.

The Chapman Valve
MANUFACTURING COMPANY
INDIAN ORCHARD, MASS.

NEW LIFE FOR YOUR STEAM ENGINES



Regardless of age, size or operating conditions, your steam engines will run better with Texaco steam cylinder oils. There is a complete line to assure maximum performance and minimum maintenance costs under all conditions. Here's how it's done:

Texaco steam cylinder oils atomize completely, coat cylinder walls and pistons with a tough, adhesive lubricating film that resists wear, wash-off and extreme heat. These oils assure steam-tight rings . . . smoothly functioning valves . . . longer engine life . . . greater economy.

If steam is used for processing, lubricate with the Texaco steam cylinder oil designed to separate rapidly from exhaust and condensate.

A Texaco Lubrication Engineer will gladly help you to better steam engine operation through proper lubrication. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Steam Cylinder Oils

FOR ALL OPERATING CONDITIONS

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.